Tappi

PUBLISHED BY THE TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY

NOVEMBER 1953

A LITTLE PARACOL® GOES A LONG WAY

Paracol wax emulsions are helping to solve many sizing problems while often effecting marked economies in size furnish. Paracol 403R6, for example, is especially valuable in surface sizing—calender stack or size press. When used in small quantities with starch, it improves liquid repellency and printability of paperboard.

In size press use, one mill found that as low as 0.25% Paracol 403R6 in its starch mix eliminated feathering on bond papers. Another mill reduced internal size usage from 1.5%-2% to 0.5% on all grades of paper by using Paracol 403R6 with starch.

More than a dozen types of Paracol wax emulsions meet practically every paper and paperboard sizing need. The complete Paracol family is described in this new book. Write Hercules for your copy.

PP53-7

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Paper Makers Chemical Department

HERCULES POWDER COMPANY

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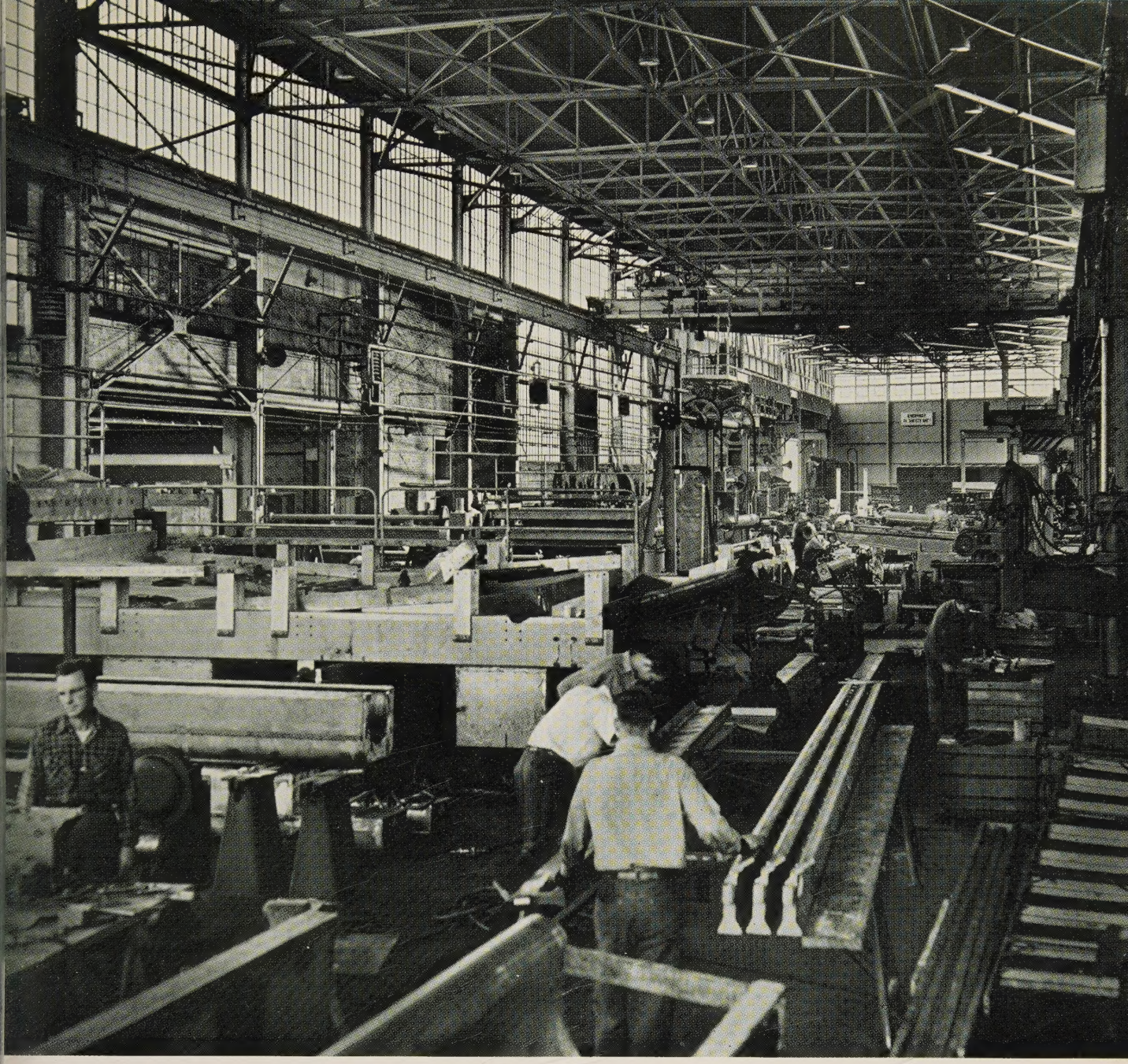
SIZING MATERIALS AND CHEMICALS FOR PAPER



SPEEDED DELIVERY of Beloit paper machinery is the result of plant expansion, new equipment and reorganization for greater efficiency. Improvements include the new main erection floor, 500 feet long. Three heavy-duty cranes help to speed assembly and shipment of Air-cushioned Inlets, Fourdriniers, calenders, winders and other equipment for leading paper mills.—*Beloit Iron Works, Beloit, Wis.*

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It is said that a wise Sioux medicine man once discussed the matter of making a living with *Miranda Aurantia,* the garden spider, who told him: "Coating control is the all-important factor. With it, I wrap up job after job very profitably. Without it, I wouldn't be worth a 'sou'."

There's something extremely significant in that for you, Mr. Papermaker—since it's your business to provide satisfactory finished sheet to meet numerous specifications. The importance of coating control is something you have occasion to recognize daily.

And that makes us confident we can serve you to your great advantage—for we have lived closely with paper coating problems for many years, and have developed the most complete line of paper coating chemicals available. These Nopco* products are specially designed to help you solve problems of viscosity control, foaming, even distribution, dusting, gloss, and moisture content.

When our technical representative calls, let him show you how Nopco coating aids—defoamers, emulsifiers, plasticizers, and eveners—can help you wrap up job after job satisfactorily...meeting all of your customers' specifications with just the finished sheet required.

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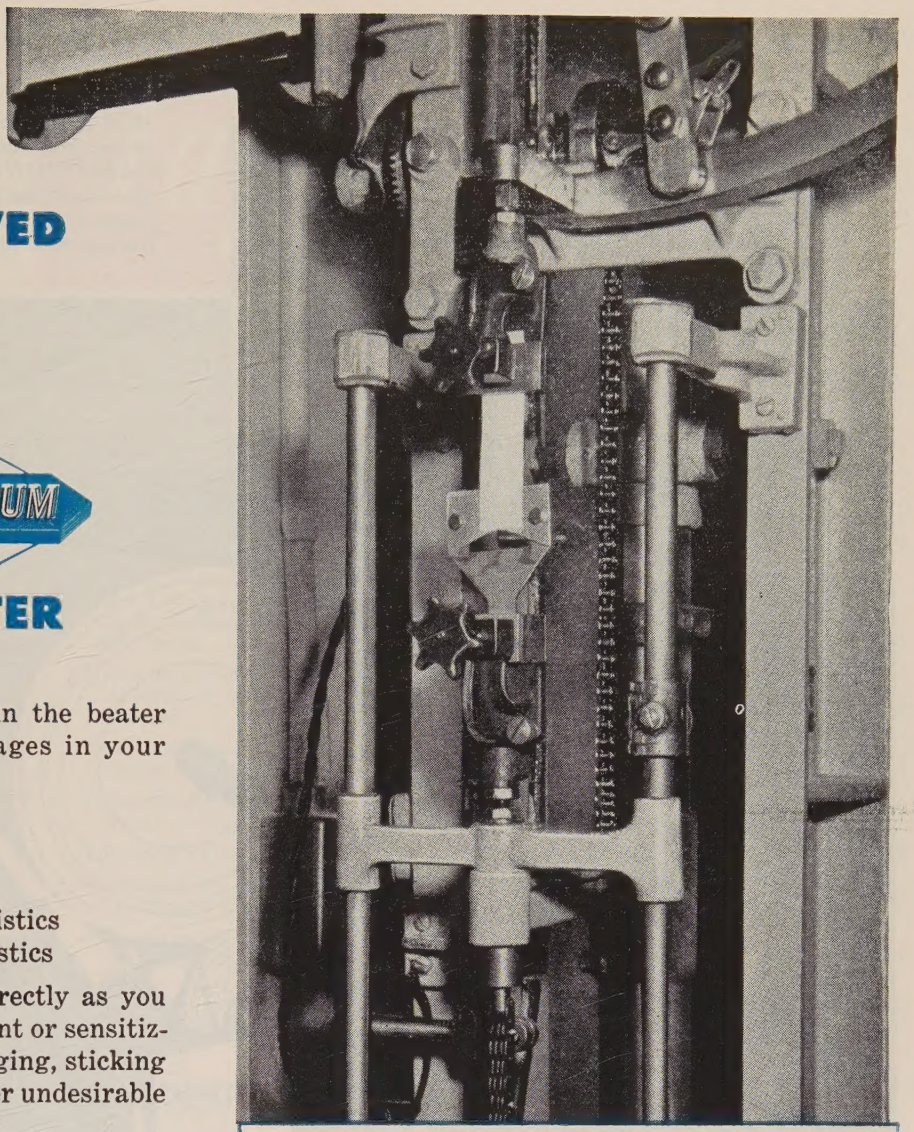

ADDITION of CHEMIGUM Latex in the beater results in all these advantages in your finished Kraft stock:

Improved Edge Tear
Increased Stretch
Added Burst Strength
Improved Bending Characteristics
Improved Folding Characteristics

You can add CHEMIGUM Latex directly as you receive it—need no special equipment or sensitizing process. You get no screen clogging, sticking on press rolls or to the drier, or other undesirable results.

CHEMIGUM Latex has been most successfully impregnated in Scandinavian pulp, mixtures of Scandinavian and hardwood pulps, Southern, West Coast and Canadian pulps.

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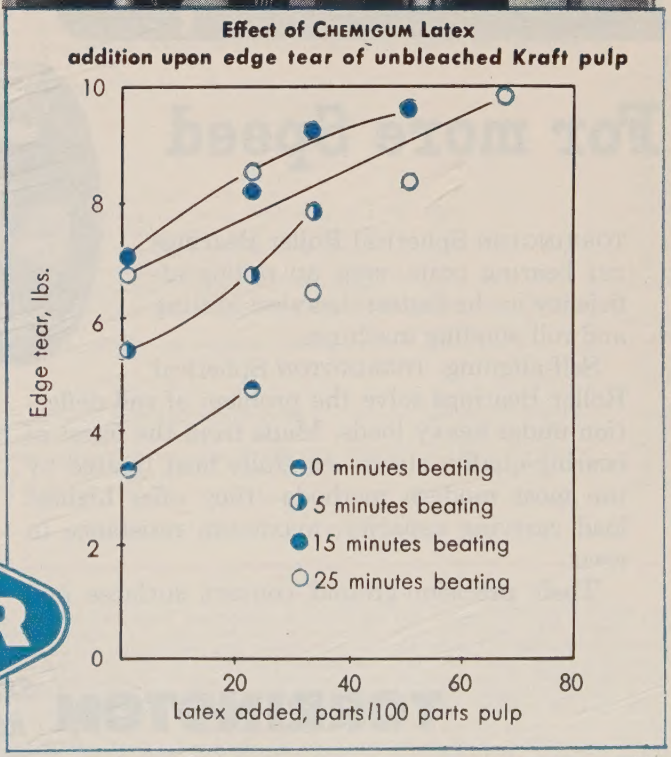

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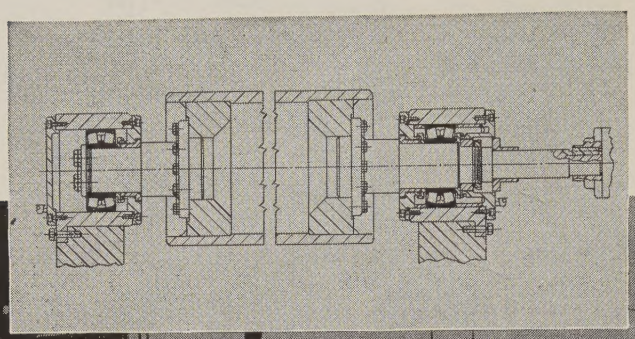
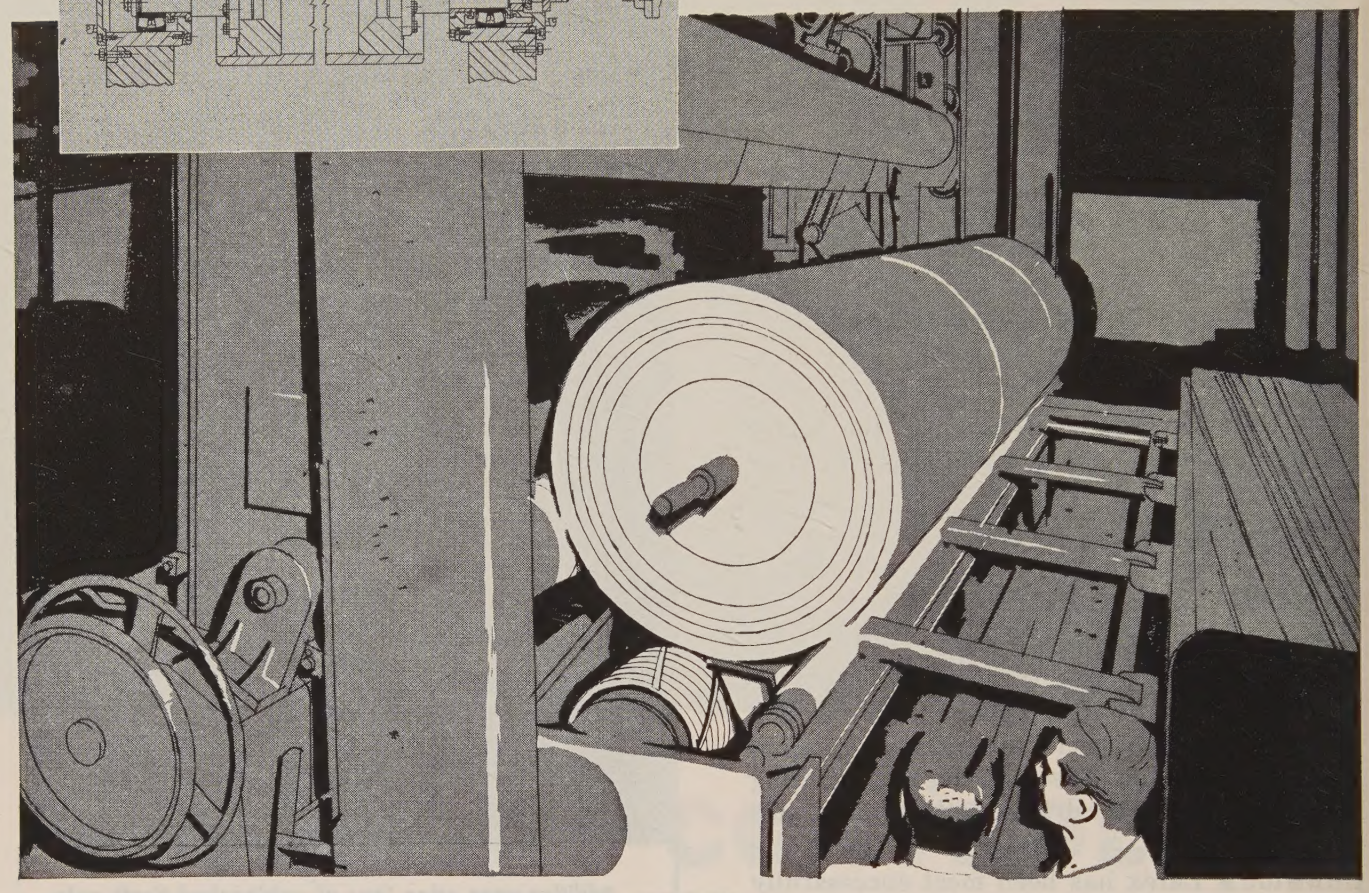
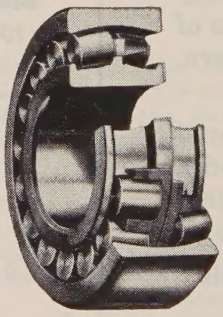


With self-aligning TORRINGTON Spherical Roller Bearings on front and rear rewind rolls, the CAMACHINE "Imperial 100"—one of the world's fastest slitting and roll winding machines—handles paper board 234" wide at speeds up to 6000 fpm, rewinding it in rolls up to 72" in diameter.



For more Speed



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Self-aligning, TORRINGTON Spherical Roller Bearings solve the problem of roll deflection under heavy loads. Made from the finest of bearing-quality steels—carefully heat treated by the most modern methods—they offer highest load carrying capacity, maximum resistance to wear.

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Specify TORRINGTON Spherical Roller Bearings for your own slitting and roll winding machines—and for your wet-end and drier sections as well. One installation will show you why it pays!

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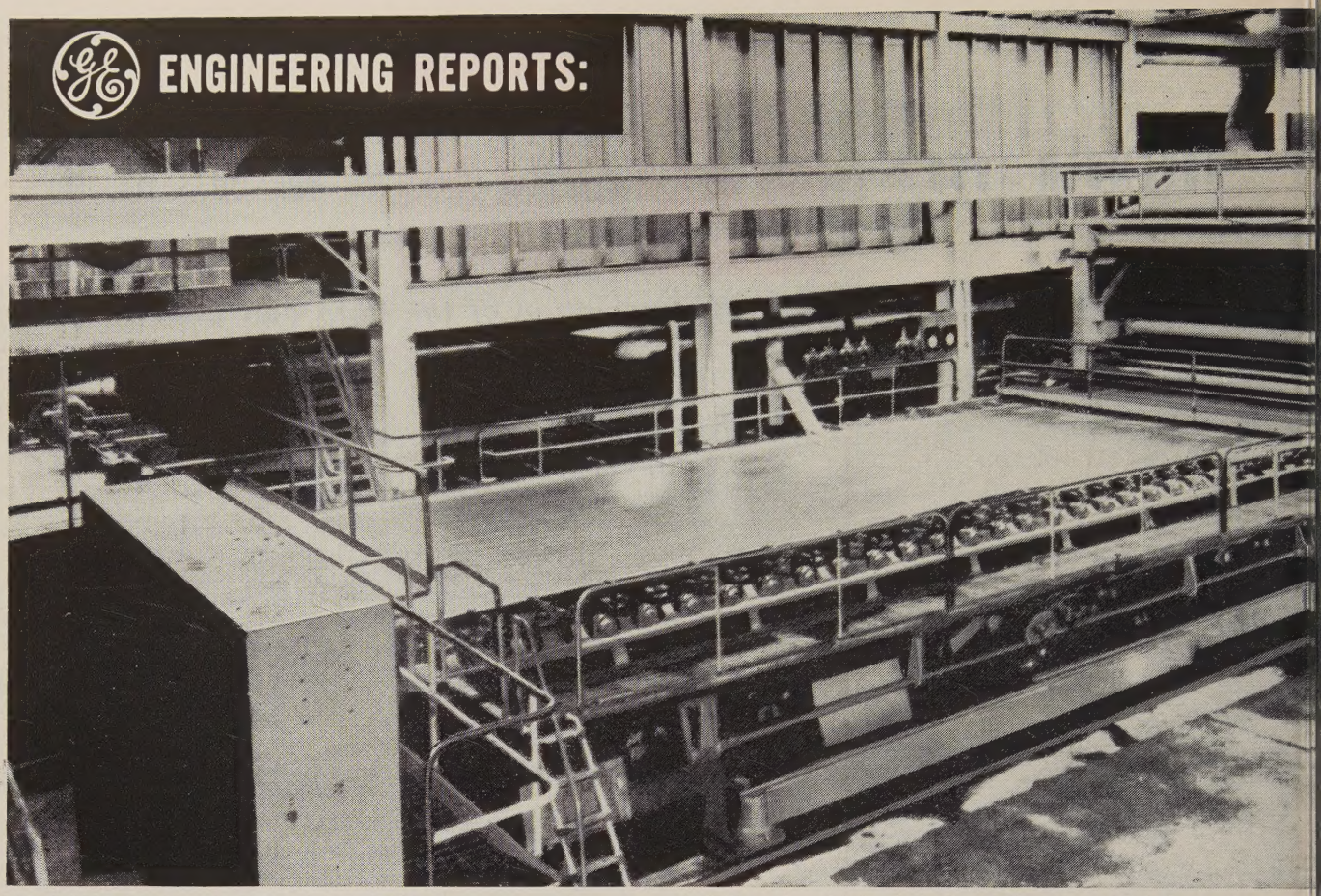
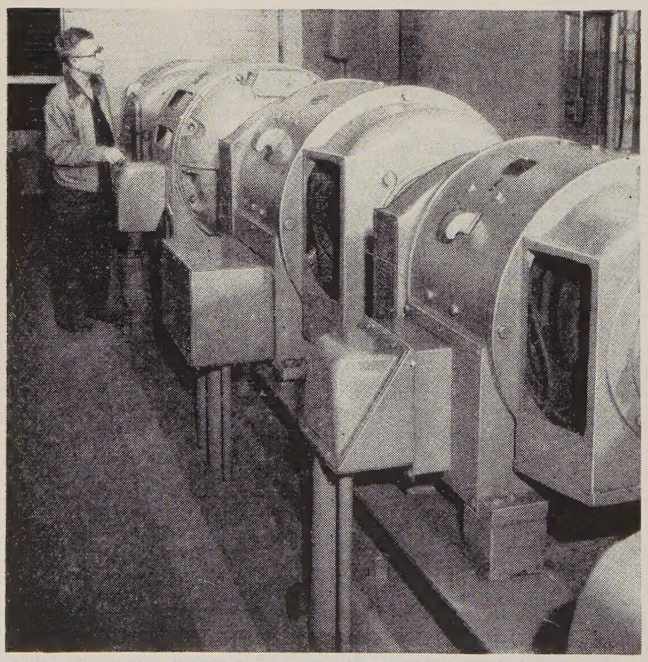
ENGINEERING REPORTS:

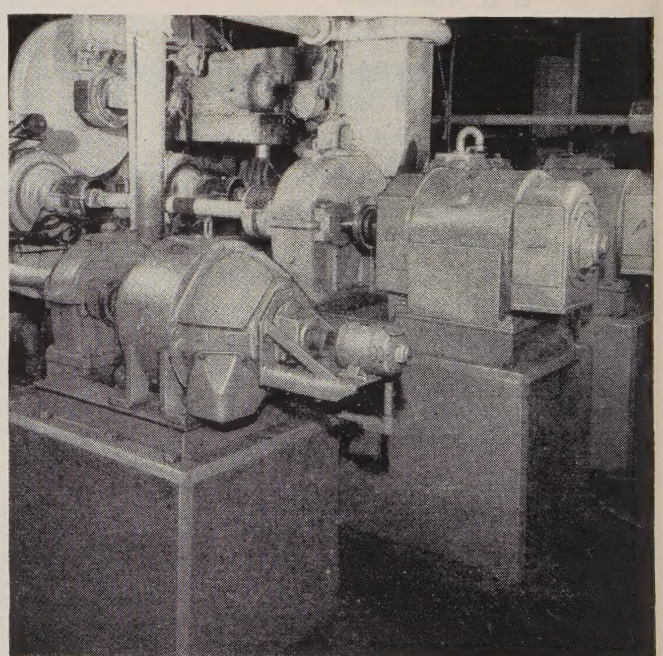


INCREASED HIGH-QUALITY PRODUCTION pours from Crossett's lightweight pick-up machine at speeds up to 1900 ft./min. A G-E sectional drive helps keep the output high by maintaining draws accurately, and responding to adjustment quickly.

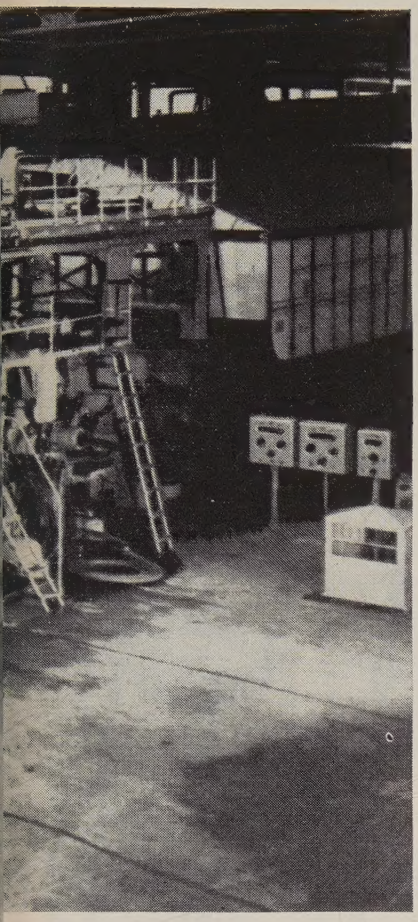
First high-speed lightweight pick-up

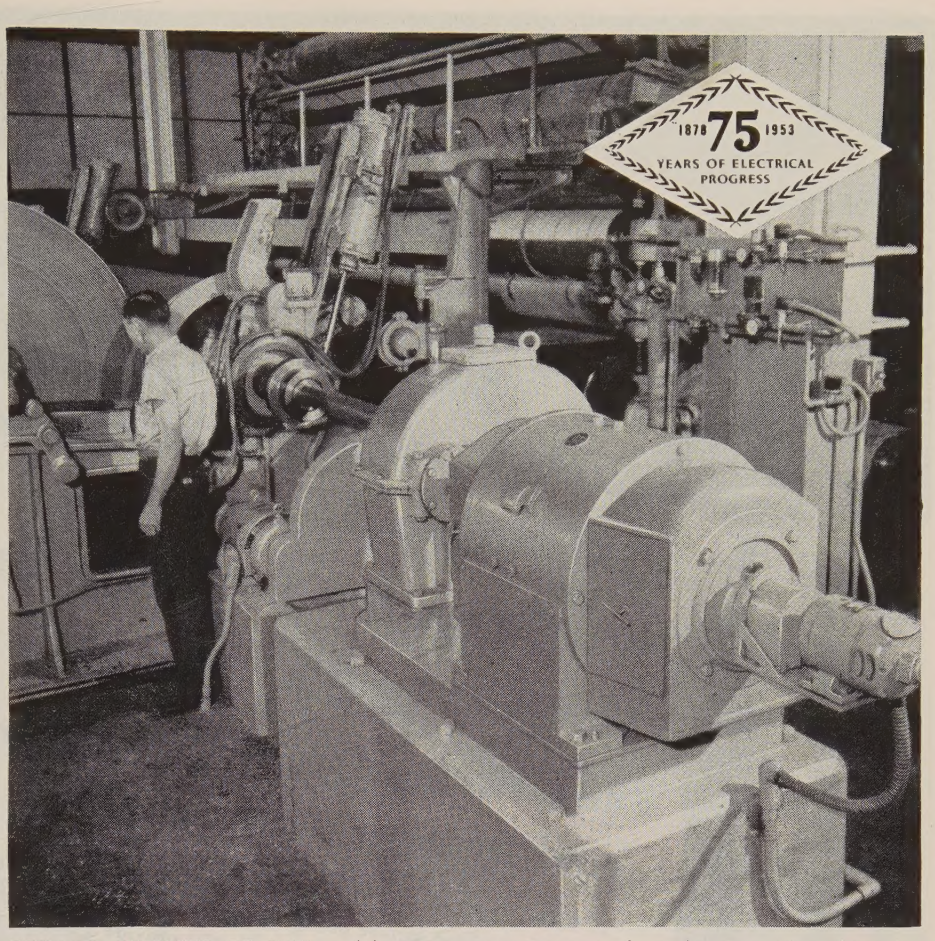


MULTIPLE-GENERATOR MEANS INDIVIDUAL DRIVES. Each section operates efficiently with fast, accurate control. Starting generator, with its complicated switching, is eliminated.



OPERATION IS CONVENIENT, PRECISE. Smooth press drive (30-hp G-E motor) and clover leaf drive (150-hp G-E motor) have fast slack take-up control for quick machine adjustment.





DRIVE FLEXIBILITY AT REEL—with more accurate control of sheet speed and tension —results in more uniform rolls. Tensiometer control of sheet tension is readily added.

averages 171 tons per day at Crossett

216-in. machine at Crossett Paper produces high quality kraft at speeds up to 1900 ft./min.

Production figures at the Crossett Paper Mill, Crossett, Ark., prove today's high-speed suction pick-up machines can turn out lightweight kraft at record rates.

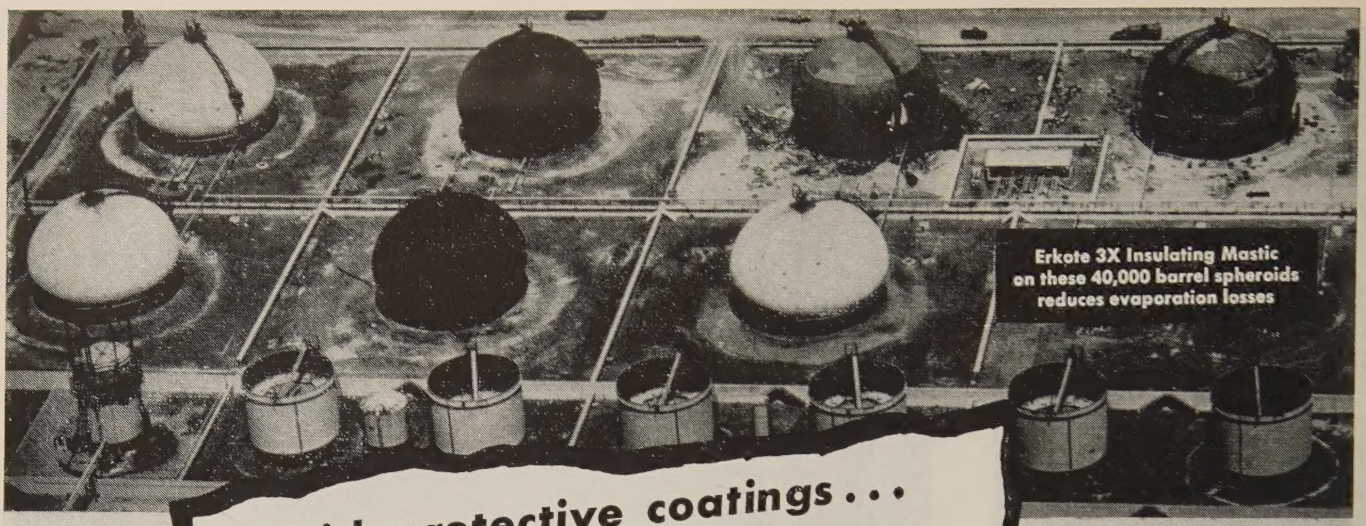
In 1950, the first machine of this type went into operation at Crossett. Since then, this machine has operated at normal speeds of 1500–1800 ft./min., 24 hours a day, every day, with a minimum of unscheduled maintenance.

The machine's specially designed General Electric sectional drive, which increases flexibility by providing an individual motor and generator for each section, has helped reduce machine outages. With this drive, sections can be operated independently or together to speed wire and felt changes. Since section ammeters often indicate mechanical difficulties before they arise, preventive maintenance techniques can be used. The result: greater continuity of production.

If you would like to learn more about how G-E drive engineering can be applied to your paper machines—whatever the grade of paper—contact your G-E Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 655-14

Engineered Electrical Systems for Paper Mills

GENERAL ELECTRIC



Erkote 3X Insulating Mastic on these 40,000 barrel spheroids reduces evaporation losses

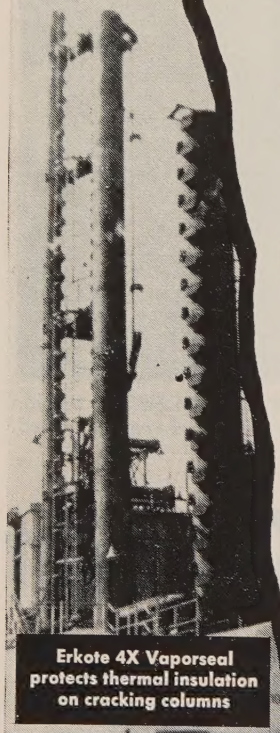
With protective coatings . . .

on-the-job performance is what really counts!

ERKOTE® Mastics have a record of proven dependability

In refineries, in paper mills, in chemical plants . . . in every type of industry where surface protection is a problem . . . ERKOTE Insulating and Corrosion Resisting Mastics provide a permanent protective coating. They are bonded to the surface in one seamless application that offers unusual resistance to chemicals, corrosive fumes and extreme weather conditions. Even under severe thermal changes, ERKOTE Mastics remain flexible . . . never dry out or peel off!

In addition, we produce our own mastics and paints and furnish our own trained crews to apply and maintain ERKOTE products. One source—one responsibility—for materials and workmanship!



Erkote 4X Vaporseal protects thermal insulation on cracking columns

Erkote 2X Corrosion Resisting Mastic protects this elevated water tower

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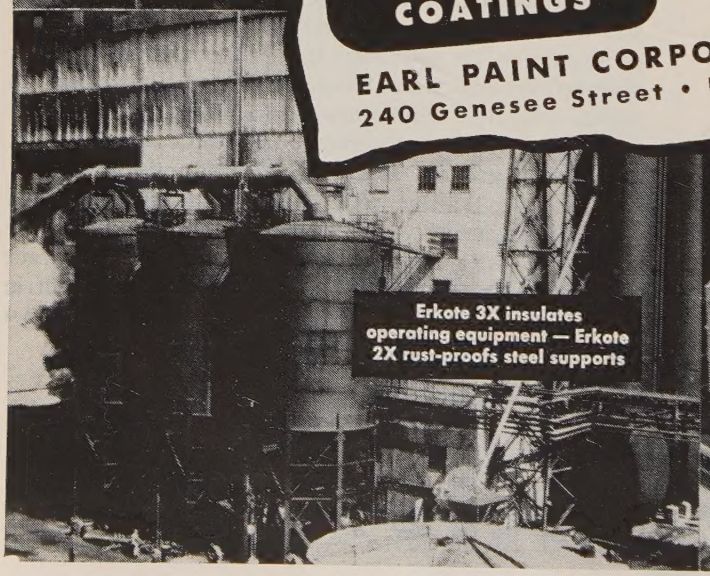
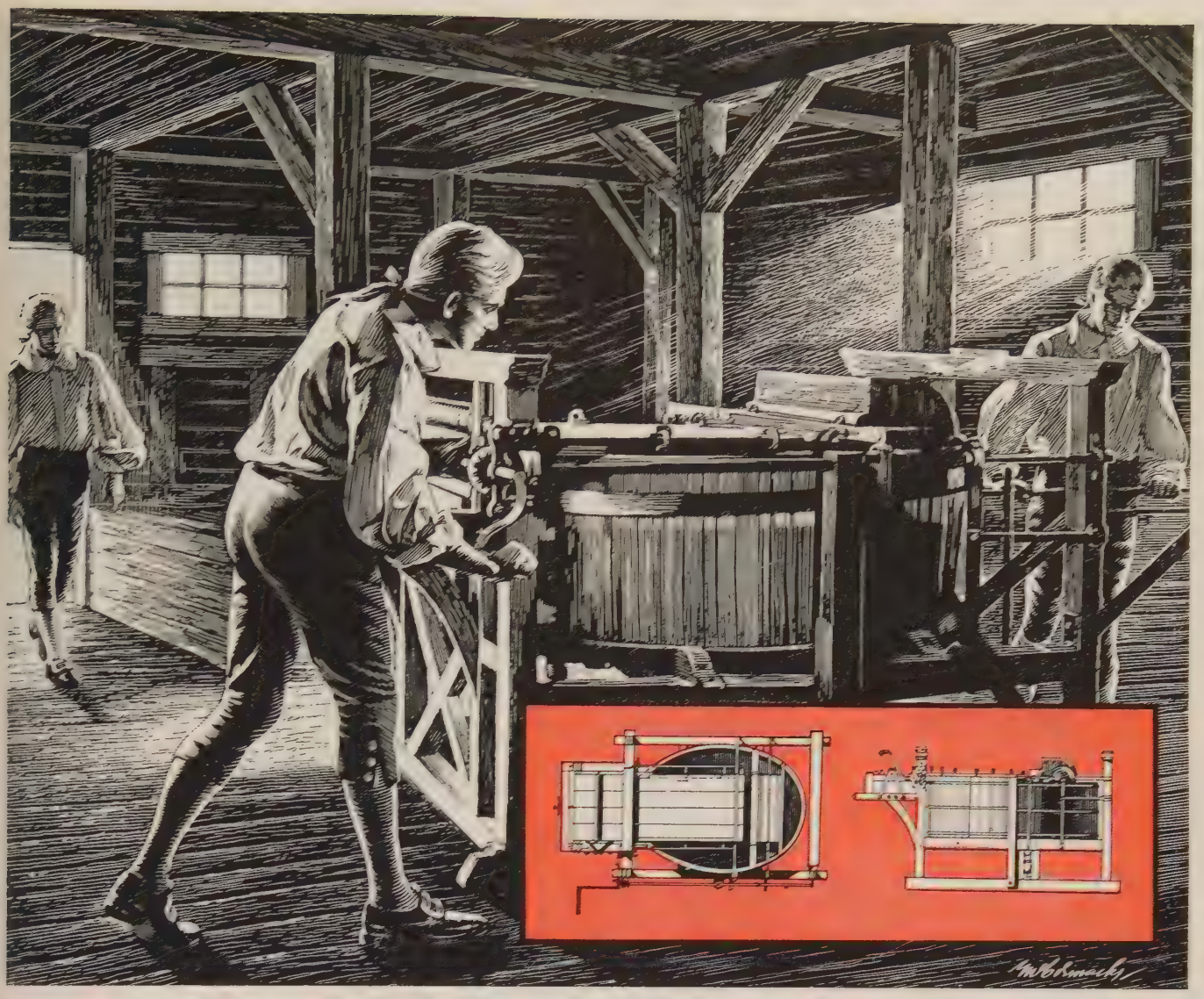


Erkote 3X insulates operating equipment — Erkote 2X rust-proofs steel supports

Erkote Mica Mastic waterproofs and beautifies these masonry buildings



Papermaking Went Into High Gear With This Machine in 1798...

An important event in the history of papermaking was Nicholas-Louis Robert's invention of the paper machine over a century and a half ago. No longer would the slow methods of forming paper by hand limit size and quantity of paper sheets. Robert's machine formed paper of continuous length upon an endless woven-wire cloth which retained the matted fibers. Today more complex machines, operating on the same principle, produce a tremendous volume of paper. Helping maintain its quality are high-grade raw materials produced by A. E. Staley Manufacturing Company, supplier to leading mills for more than 30 years. Discover the many advantages Staley can offer *you*. See your supplier or write for details today.

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A full range of starches and dextrins for beater, surface and calender sizing.

Staley Corrugating and Laminating Adhesives
Corrugating starches, special laminating and bag adhesives.

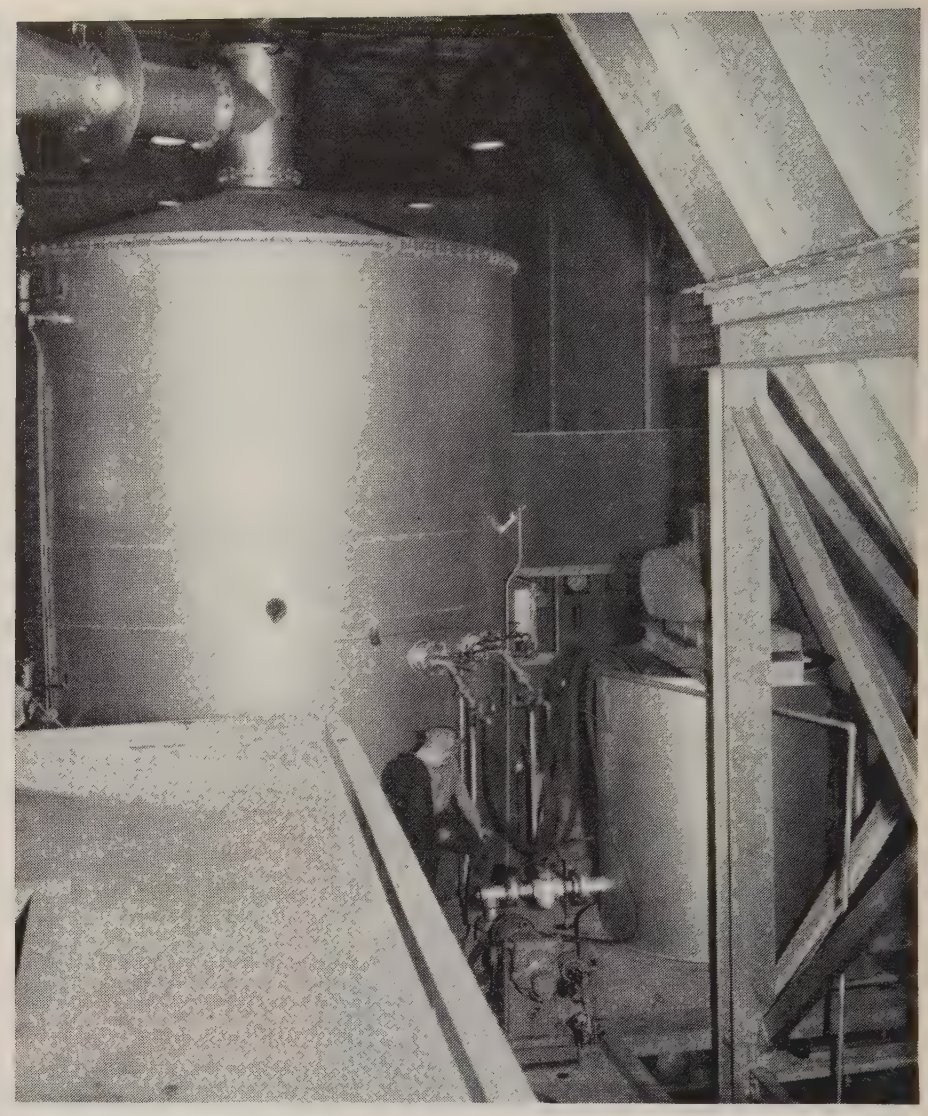
Staley Coating Adhesives
Starches and Dextrins give better results for machine or regular brush coating.

Staley Plasticizers
"Sweetose"® and Staley's corn syrup are ideal softening agents for glassine paper.

PRODUCTS FROM CORN
Staley's

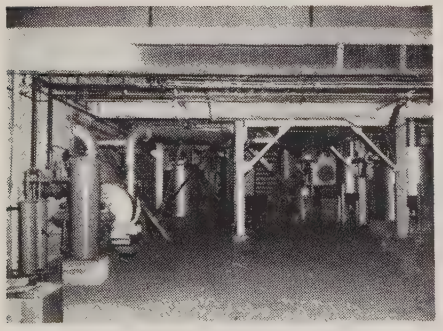
A. E. Staley Mfg. Company, Decatur, Ill.

ACID Requirements of Sulfite Pulp Mill are met with Dorrco FluoSolids System



Closeup of Dorrco FluoSolids Reactor at Port Arthur showing slurry storage tank and dual feeding arrangement.

PORT ARTHUR, ONTARIO — At the Thunder Bay Mill of Abitibi Power & Paper Company, Ltd., a Dorrco FluoSolids System has been on stream since June, 1953 producing SO_2 gas from pyrite. The System at the present time is roasting 20 tons per day of pyrite to supply the entire sulfur requirements of this sulfite pulp mill. Up to 14% SO_2 gas is produced which passes through a two-stage cyclone system followed by a cooling scrubbing tower before going to the acid towers. An interesting feature of this installation is the use of a heat-exchanger in conjunction with the scrubber. By recycling scrubber water, loss of dissolved SO_2 is minimized and at the same time waste heat recovery is effected.



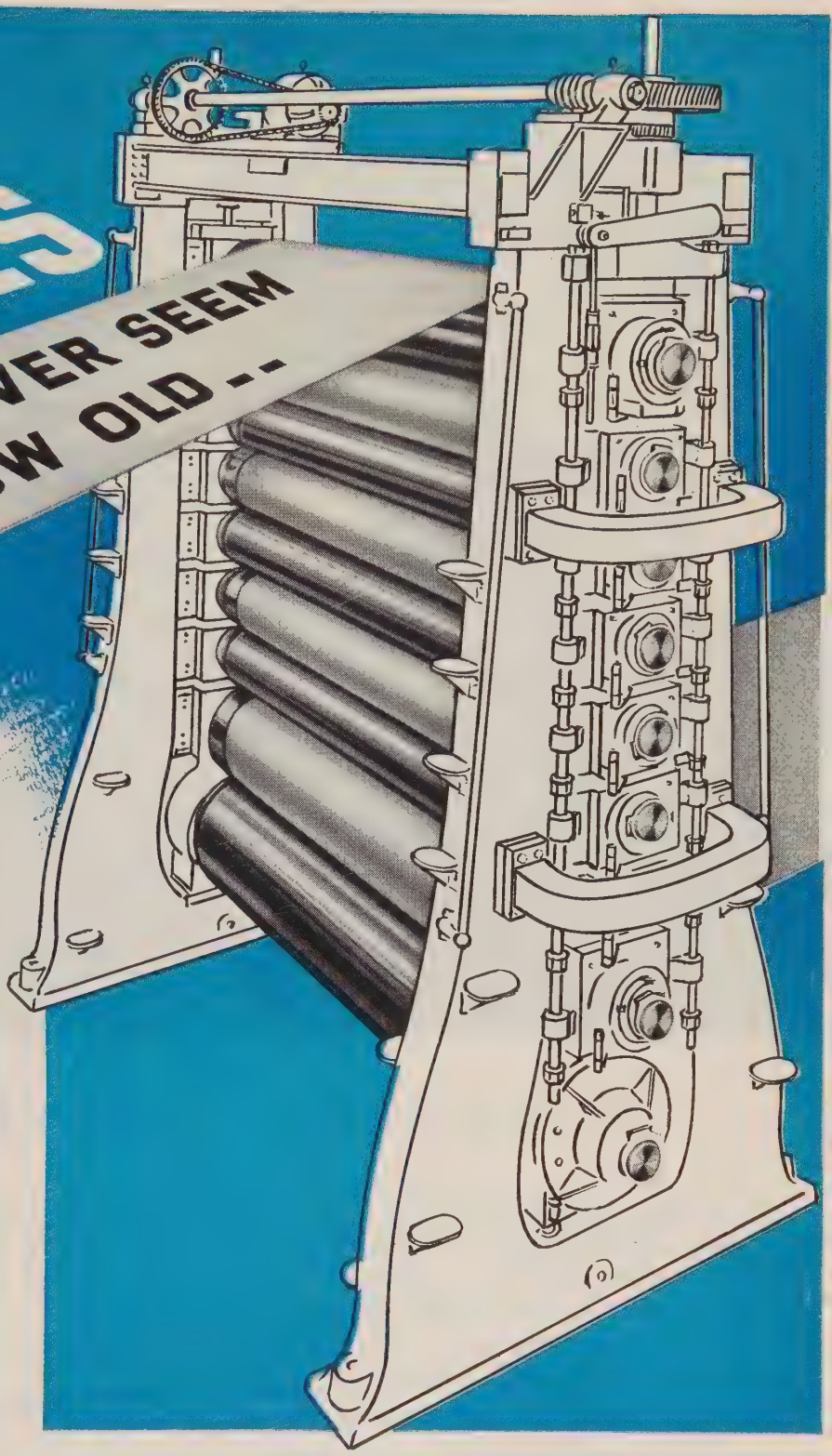
Bottom floor of Reactor building showing blower at left and cyclone quench tanks at right. Reactor windbox is visible at right center.

In addition to this installation at Abitibi's Thunder Bay Mill, seven more FluoSolids Systems in the U. S., Canada and Norway are either in operation or under construction in sulfite pulp mills for the production of SO_2 for cooking liquor. Fourteen more are in operation or being installed to produce SO_2 from pyrite, zinc and low grade sulfur ores at acid plants, which will produce close to a million tons per year of H_2SO_4. This impressive record results directly from the fact that the FluoSolids process can deliver an SO_2 gas at lower investment and operating costs than conventional roasters and provides users with an economically feasible and reliable source of SO_2 despite fluctuations in natural sulfur supply.

If you would like more information on FluoSolids — the most significant advance in roasting technique in the last 30 years — write The Dorr Company, Stamford, Conn., or in Canada, The Dorr Company, 26 St. Clair Avenue East, Toronto 5.

*FluoSolids is a trademark of The Dorr Company, Reg. U.S. Pat. Off.

ROLLS THAT NEVER SEEM TO GROW OLD --



Farrel rolls work to a ripe old age, long after other rolls have been retired. There is no great secret . . . A CENTURY OF EXPERIENCE in making a wide variety of rolls guides Farrel engineers in determining the proper metal mixture, and in designing the roll to withstand the punishment it will receive in the calender.

SURFACE HARDNESS prolongs accuracy of the roll face and, as a result, lengthens the time between regrindings.

CHILL OF CORRECT DEPTH means that the roll may be reground many times before its usefulness is ended.

In Farrel rolls the thickness of chill and gray iron body are combined in correct proportion to provide MAXIMUM SERVICE LIFE.

The chilled section is sufficiently hard and deep to resist crushing and abrasion. The structure of the body provides the strength to carry the load imposed on the roll in the service for which it was designed.

Farrel rolls are made in the LARGEST SPECIALTY ROLL SHOP in the world. For the complete story of these rolls send for a copy of Bulletin No. 116. No cost or obligation.

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FB-843

Would Ivan live in this "house of cards"?

Chances are Ivan would just love to move into a house like this . . . if he could manage it. But, of course, he couldn't afford it. Too, his country can't begin to match ours in production of one of the important ingredients of this house—4′x8′ "cards" of wallboard, a product of our giant pulp and paper industry.

Wallboard is only one of dozens of ways in which our American paper makers have helped make our life better. Others are: Paper facial tissues, paper shipping cartons, paper milk containers, and many additional applications of paper and pulp products which offer improvements on older methods.

We of Pennsalt proudly salute the paper and pulp industry in its gigantic project of making paper meet the various needs of our country in any way that paper might serve. And we are pleased that our chlorine, caustic soda, hydrogen peroxide and corrosion-resistant cements are helping the great paper industry.

PENNSYLVANIA SALT MANUFACTURING COMPANY

East: 291 Widener Building, Philadelphia 7, Pennsylvania
West: 2901 Taylor Way, Tacoma 1, Washington

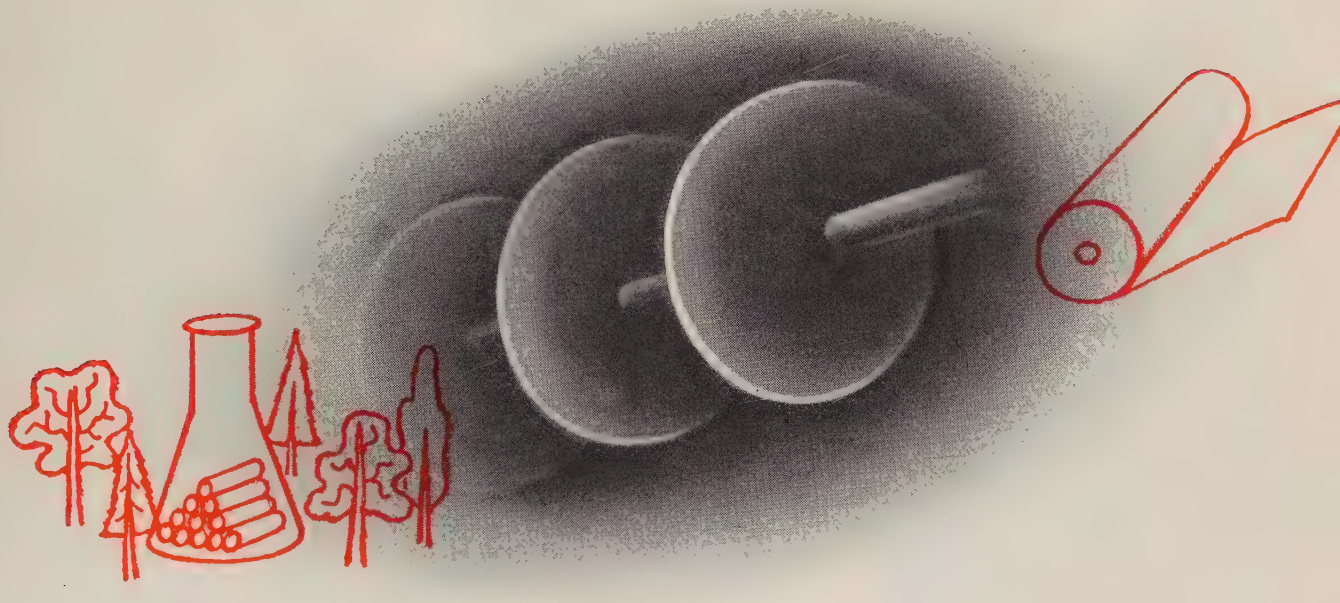
Pennsalt Chemicals

Progressive Chemistry for Over a Century

meeting the needs of the present
with an eye toward the future

PANDIA

CONTINUOUS PULPING EQUIPMENT



Today's heavy demands for the pulp requirements of prominent mills in this country and elsewhere making products ranging from board to bleach grades are being met with continuous digesters—designed, engineered and manufactured by Pandia, Inc., leaders and trail blazers in the field of chemical pulp processing.

These mills are sufficiently foresighted to install equipment that will be equal to the task of even heavier demands for high quality pulp for the complete range of paper products in tomorrow's markets here and abroad.

One of Pandia's engineers will be glad to consult with you concerning plans for your new plant or for modernizing your present operations.

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THE URGENT NEEDS OF THE INDUSTRY

D. W. AMBRIDGE

D. W. Ambridge

FIRST of all I should like to tell you how much I appreciate the invitation to speak to this Engineering Conference. I understand that this is the first time you have had this meeting in Canada and I am sure I speak for everyone in the Canadian industry when I extend to you all a very warm welcome.

When Mr. Macdonald wrote and asked me to come here I replied that I would be very glad to do so because I have had a lot of things on my chest for some time and this is certainly a good opportunity to get some of them off.

Many of you may be under the impression that I am an engineer, and I, therefore, feel it is my duty to let you in on a secret which I have kept to myself for as long as I could. The secret is that although at one time I *was* an engineer, the passage of time (and there has been a lot of time pass over and around me) has wiped from my mind most of the knowledge which an engineer is supposed to possess.

When I first got a job in the pulp and paper industry I was an engineering student. After I graduated I worked in a mill as an engineer, but as I painfully climbed the ladder I found myself doing less and less engineering and more and more other things, much less interesting things. Today I find that I have forgotten most of what is generally regarded as engineering knowledge. What is worse, I find that I am now flanked on one side by lawyers and on the other by accountants. You can imagine my plight when I confess to you that I know no law and less accounting.

So it is somewhat surprising to me that I should be invited to speak before a group of real engineers, and that I should be expected to choose an engineering subject. But I will do my best.

I need not remind you that our industry is a mass production industry. We turn out vast quantities of various and sundry kinds of paper on huge heavy machines running at high speeds. It is also an essential industry whose product is absolutely necessary in the complex world economy which has been developed during the last century or two. An outstanding leader in the industry in the United States, Cola G. Parker, speaking before the National Industrial Conference Board early this year, pointed out, among other things that even as early as 1777 George Washington directed the release of all papermakers from the Continental Army because their service in the mills was more essential than their service in the army. Mr. Parker also reminded his hearers that during the last war Donald Nelson of the W.P.B. organized a special bureau to assure adequate paper production, remarking as he did so that "We made the mistake of taking paper for granted, just as we do air and water. We now recognize its essentiality."

Our industry also is remarkable for the cheapness of its products, an outcome of its methods of mass production. Paper indeed is a synonym for cheapness as any of you who have ever signed a contract that was not worth the paper it was written on, can testify.

I am going to ask you now to consider one aspect of this very large industry which, in my view, has been lost sight of in recent years by the engineers whose duty it is to keep the supply of paper adequate and the price of paper low.

We have not, of course, nearly enough time to deal with my subject exhaustively but if I can arouse your interest I am quite confident that you gentlemen can do something to rectify the conditions I am about to describe.

All of you have something to do with the purchase of equipment for the mills in which you work as engineers and all of you must have remarked upon the fantastic prices which paper manufacturers nowadays pay for even the most insignificant little pump or headbox. It is quite literally true that none of us can turn around in a mill without spending many thousands of dollars.

Most of us have been content to dismiss this very grave problem of the cost of equipment by thinking that the price of everything is going up and that it would indeed be strange if prices for mill machinery did not go up too.

This is very true but there are other ways of looking at the problem which I hope will give all of you some food for thought.

We might start, for instance, by comparing the cost of very commonly used pieces of equipment in our mills with other mechanical units used commonly elsewhere.

They tell me that here in Canada a Cadillac motor car can be had for $6000 by those who have that much money to spend on transportation. Now a shiny new Cadillac car is a masterpiece of intricate machinery, so put together that even the dumbest blonde can endanger her own life and the lives of others by driving it at 70 or 80 miles an hour, with a minimum of experience and know-how.

D. W. AMBRIDGE, President, Abitibi Power & Paper Co., Ltd., Toronto, Ont.

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Now let us look at the prices we must pay for some of the equipment we buy and let us compare them with this prodigy of human ingenuity—the Cadillac car.

Here is a list which I hope will illustrate adequately the point I am trying to make.

1. A high-speed winder for a 154-in. paper machine costs us $72,000 which is what 12 Cadillacs can be had for.

2. A plain ordinary decker with a capacity of 100 tons of pulp a day costs $18,000—the price of three Cadillacs.

3. A vacuum washer for pulp is sold for $36,000—the price of six Cadillacs.

4. I heard the other day that one company installed a new headbox and slice on one of their machines and before they got finished with the job they had spent $200,000—a handsome sum, enough to buy 3 dozen Cadillacs.

Now you will say to me that this is not a fair comparison because the motor car industry turns out millions of cars, and because they probably pay just as much as we do for the equipment they use in their manufacturing operations.

This may be so but it does not, in my view, destroy the validity of the point that the cost of any equipment used in any manufacturing operation is disproportionately high.

What is much more important is that I feel sure that the prices of mill equipment can be lowered, if we set about it intelligently, and if we engineers recognize that it is part of our duties to see that the capital costs of the plants we build are not burdened with unnecessary expenses.

Why is this question of the fantastic cost of mill and factory equipment important and why should the engineers in industry recognize their duty to do something about it?

In the troubled World in which we live today there is one shortage above all others which, to my mind, delays the progress of mankind. This is the shortage of skilled and imaginative designers of machinery. In the Western World thousands upon thousands of designers have been withdrawn from industry to supply the needs of the armed forces. Thousands of our best men are engaged in the business of building the hideous weapons which we must have for the defense of our own firesides.

As a result our industry, all industry in fact, has no spare engineering personnel and what we have we must use as effectively as possible.

Are we, do you think, using the available engineering talent in our own industry and in the industries which supply our equipment needs, as effectively as possible?

When I assert positively that we are not I need only point to the high cost, the disproportionately high cost, of winders and beaters and refiners and suction rolls to prove my point.

If a simple winder costs as much as a dozen Cadillacs it must be because the winder represents too much energy, financial, physical, and mental. Too many people have contributed their time, energy, and knowledge to the building of that winder.

No one that I know of makes very fabulous profits out of building paper mill equipment, so we cannot demand a congressional investigation of the machinery business. I have not heard of any prosecutions under the Sherman Act. No, something else is wrong here and the reason for the high cost of equipment is not far to seek.

If we face the facts we can see at once that the engineers and operators in our own mills have not yet made up their minds what they really want in the way of machinery to perform the tasks that must be done in the manufacture of paper.

All of you have, I am sure, spent hours and hours drawing up specifications and attending meetings and writing letters about equipment you must buy or would like to buy for your mills.

You have spent hours listening to eager sales engineers discussing the superiority of some trifling variation which their particular refiner or beater or pump possesses.

Every department superintendent secretly believes that he and he alone knows how a particular machine should be built even if that machine only does a common job in his part of the mill.

Now, all of this expenditure of time and energy would be very well if we were living in a time of peace. Unhappily we are not living in peace and the time we waste arguing about what kind of bearings a machine should have or what size outlet a headbox should have is time that we cannot spare, and which we cannot afford.

This wasted time is reflected in the high cost of mill equipment, and I am here to suggest to you that it is high time we did something about it.

What can be done?

Let me share with you an experience I once had myself, the results of which I believe can be applied, to some extent, to the solution of the problem we are here considering.

During the last war it fell to my lot to direct the building of naval ships here in Canada. I found that a naval ship is very much like an industrial plant. It has its power plant, its electrical installation, its gun establishment, its living quarters. There are the usual problems of ventilation, safety, etc., etc.

I found that the Navy had rigid standards for each and every bolt, nut, switch, and gear which entered into any of the ships we were building.

And I also found that every supplier of material was doing his best to get as big orders as he could for as big a variety of goods as possible. These manufacturers of pumps and boilers and electrical equipment were working their heads off trying to do the best they could with a situation with which they could not cope.

Eventually we got the suppliers together, decided together what particular supplies and equipment could best be produced in what plants, and the shipyards then knew where they could order what they needed with some hope of getting it on schedule.

The effect of this move was amazing. The cost of the supplies was very much reduced and their volume per manufacturer was very much increased. The result was we got more adequate ships in less time for less money.

Now, of course, this was wartime, hot wartime. We are living in cold wartime but I cannot help but believe that we could save hundreds of thousands of engineering man-hours if the engineers in our industry would direct

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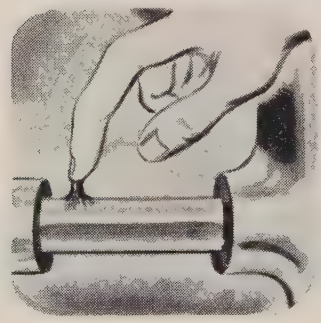

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their attention to the possibilities which must exist for standardizing as many as possible of the thousands of items which are to be found in the mills of the paper industry on this continent.

Together with the machinery builders I believe we could drastically reduce the variety of equipment and the cost of it by agreeing on standard machines to do standard jobs. I do not believe any one of us here in this room can know how much might be accomplished until we take our coats off and go to work on the problem.

You may say to me, "But surely this is not free enterprise. Surely every manufacturer is entitled to run his own business, buy what equipment he thinks best, pay for it as much or as little as his own private judgment decides without consulting his colleagues, and still less his competitors. That is the way this great industry was built and it is doing a damn good job."

I would agree with you wholeheartedly if it were not for the fact that I am alarmed by the waste of those precious engineering man-hours without which this North American civilization of ours cannot survive.

I am convinced that if government rationing were ever to become necessary again, which God forbid, the first thing for the government to ration would be engineering man-hours, because under present circumstances it is the most precious commodity we have.

Remember that there is no such thing as stockpiling engineering man-hours. Remember that the training and use of the engineering talents of our people is the keystone of the arch of our whole civilization.

I have drawn this dangerous waste of precious engineering talent to your attention because in our industry you engineers are the only body of men who can do anything about it. You are, moreover, the people who should become concerned enough about the matter to take some action and in this Association you have the organization which any action you may wish to take, requires.

Nearly a hundred years ago an American poet, Rowland Howard, wrote these lines with which I end this discourse:

"Waste not, want not is a maxim I would teach.
Let your watchword be dispatch and practice what you preach.
Do not let your chances like sunbeams pass you by
For you never miss the water till the well runs dry."

Presented at the Eighth Engineering Conference of the Technical Association of the Pulp and Paper Industry, Montreal, Que., Oct. 26–29, 1953.

39th Annual Meeting

of the

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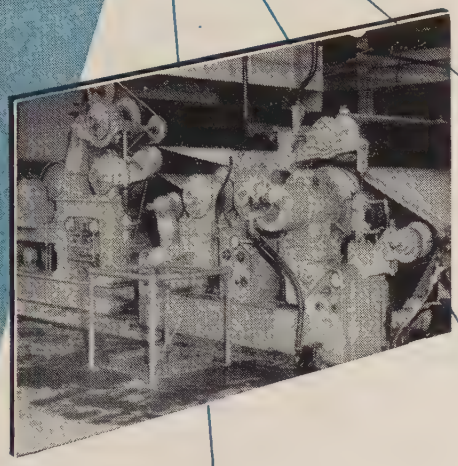

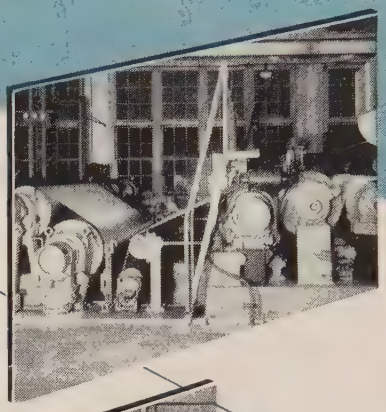

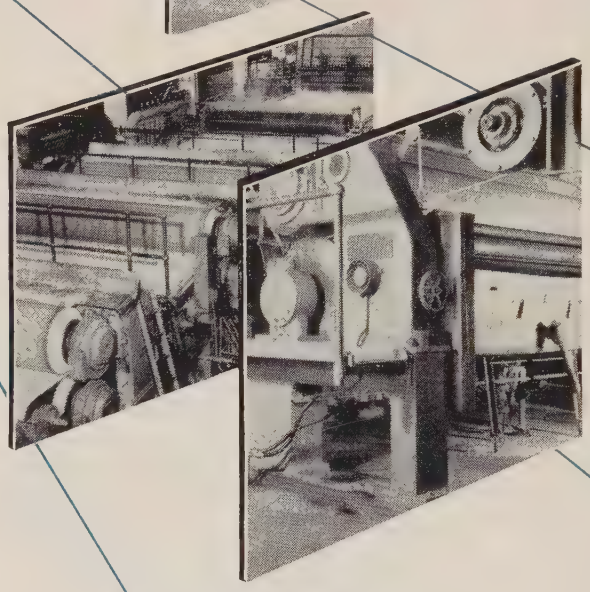

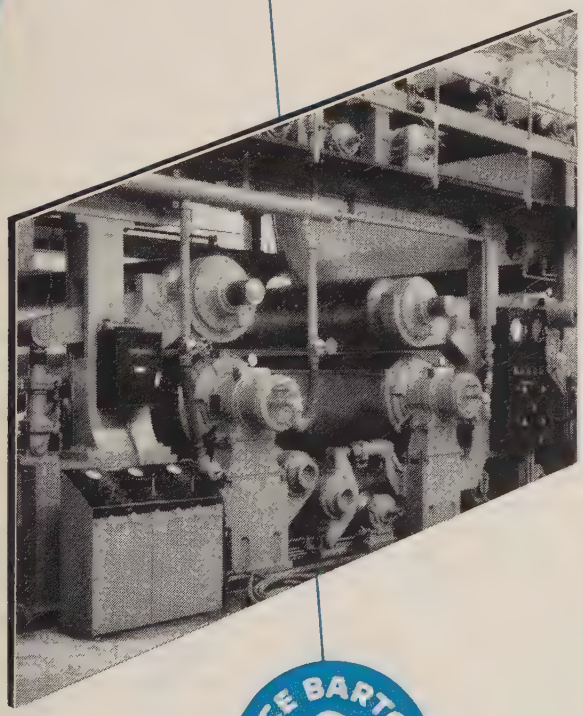

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Relative Toxicity of Disinfectants Available for Use in the Pulp and Paper Industry

B. F. SHEMA and JULIAN H. CONKEY

Microbiological growths in one form or another in pulp and paper mill systems and on pulp and paper products are responsible for significant losses in production, in the quality of the product produced, and in the serviceability of the finished product. These losses, which may vary from a few cents to several dollars per ton of product, are experienced not only by the pulp and paper manufacturer but also by the converter and the consumer. In an effort to reduce and/or to eliminate these losses, various chemicals have been suggested and used by the industry for microorganism control. Although it has been the practice for many years to use various fungicides and/or bactericides to protect paper products from the action of various fungi and bacteria it has not been until the last decade that these chemical agents have been used extensively to control the growth of microorganisms in pulp and paper mill systems, to preserve wood pulp, to increase the life of papermaker's woolen felts, and to prevent the growth of various microorganisms on finished products. This increased use of chemical agents for microorganism control has resulted in the development of disinfectants more suitable for the pulp and paper industry. Many of the materials suggested were originally used for other purposes, whereas other materials were developed or compounded specifically for the pulp and paper industry. In general, practical experience has shown that more consistent results have been obtained with the materials developed or compounded for the pulp and paper industry.

In 1941 the Biological Control Committee of the American Paper and Pulp Association recognized the need of evaluating the relative toxicity of the various bactericides and fungicides offered to the pulp and paper industry for microorganism control. The committee, therefore, agreed that a study of the relative toxicity of disinfectants offered to the industry should be included in their general program of biological research carried out at The Institute of Paper Chemistry. Active work in this particular phase of the program was begun in 1941 and has been continued to the present time. Some of the results of this study have been published by Appling and Shema (*1*) and Appling and McCoy (*2, 3, 4*).

EXPERIMENTAL PROCEDURE

When the study of the relative toxicity of disinfectants offered to the pulp and paper industry was initiated, there was a lack of data on the toxicity of these materials to some of the microorganisms commonly found in pulp and paper mill systems. It was necessary, therefore, to ascertain first the most practicable method of determining the toxicity of these materials. Since it was not feasible to determine the toxicity of the different chemical agents under mill-operating conditions, it was decided to evaluate these materials under laboratory conditions. In selecting the laboratory procedure, it was realized that these procedures have certain limitations. The principle disadvantage of a laboratory procedure is that the conditions of test do not duplicate such mill conditions as variations in the furnish, in the temperature of the mill system, in mill design, in the microbiological complex, etc. On the other hand, most of these factors do not remain constant in any given mill system for any appreciable length of time. Therefore, to determine the relative toxicity of a large number of chemical agents under mill-operating conditions, it would be necessary to evaluate each material under the same conditions in a given mill system; this would be extremely difficult, time consuming, and very expensive. Since it is impossible to maintain uniform conditions in a given mill system for any extensive period of time, a laboratory procedure was selected because the relative toxicity of the various chemical agents could be determined under standardized conditions.

It should be pointed out that the results obtained with a given laboratory procedure do not necessarily indicate the dosage required to give satisfactory microorganism control nor do the data indicate the relative effectiveness of each material under the different operating conditions encountered in the pulp and paper industry. However, the relative toxicity data provide the mill operator with a basis for the selection of an effective slime-control agent for his mill. That is, if a particular slime-control agent is found to be ineffective under laboratory conditions, it is likely that this material will be ineffective under normal mill-operating conditions. It follows also that, if a material is found to be effective under laboratory conditions, it will be effective under normal mill-operating conditions provided that the chemical agent is not biologically inactivated in the mill system or that the mill system does not contain a microbiological complex which is highly resistant to the particular slime-control agent. In general, it has been found that a material which has a high order of toxicity under laboratory conditions will also have a high order of toxicity to the microorganisms found in most pulp and paper mill systems.

For this study, two species of bacteria and two species of fungi were selected as test organisms. The bacterium *Aerobacter aerogenes* was selected as one of the test organisms because of the frequency with which this capsulated nonsporeforming organism has been isolated from pulp and paper mill slimes. This particular strain

B. F. Shema and Julian H. Conkey, The Institute of Paper Chemistry, Appleton, Wis.

2 B&W MgO RECOVERY UNITS to serve pulp mill in ALASKA

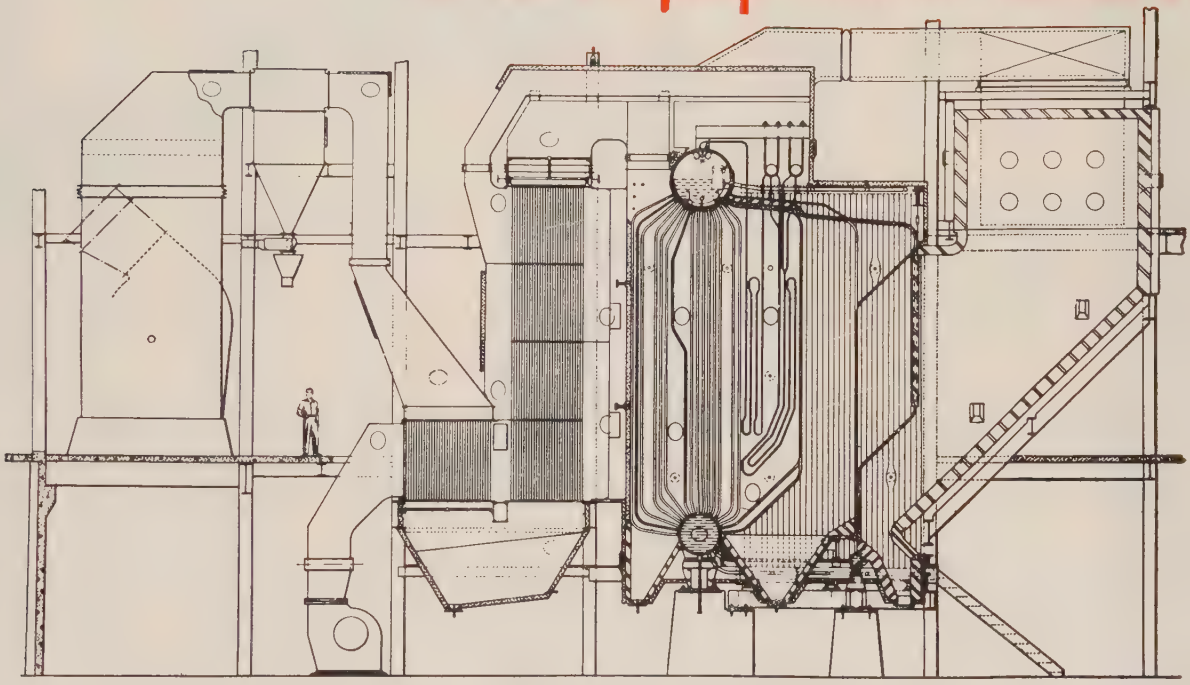

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Table 1. The Relative Toxicity of Various Materials to *Aerobacter aerogenes*, *Bacillus mycoides*, *Aspergillus niger*, and *Penicillium expansum*

Trade name of disinfectant	Inhibiting concentrations: *Aerobacter aerogenes* Per cent by weight	*Aerobacter aerogenes* P.P.M.	*Bacillus mycoides* Per cent by weight	*Bacillus mycoides* P.P.M.	*Aspergillus niger* Per cent by weight	*Aspergillus niger* P.P.M.	*Penicillium expansum* Per cent by weight	*Penicillium expansum* P.P.M.
Arquad 2C	0.15	1500	0.0035	35	>0.30	>3000	>0.30	>3000
Arquad 2C Oleate	>0.30	>3000	0.004	40	>0.30	>3000	>0.30	>3000
Arquad 12	0.008	80	0.0065	65	>0.30	>3000	>0.30	>3000
Arquad 18	>0.30	>3000	0.0055	55	>0.30	>3000	>0.30	>3000
Arquad S	0.15	1500	0.0035	35	>0.30	>3000	>0.30	>3000
ATM-50	0.05	500	0.0004	4	>0.30	>3000	0.25	2500
ATM-X3	0.85	850	0.0009	9	>0.30	>3000	0.20	2000
Benochlor 3C	0.20	3000	0.0075	75	>0.30	>3000	>0.30	>3000
Benzyl parasept	0.0085	85	0.0045	45	>0.30	>3000	>0.30	>3000
Bionol A	0.015	150	0.0015	15	>0.30	>3000	>0.30	>3000
BSM-11	0.0025	25	0.0003	3	0.0025	25	0.0025	25
BSM-11B	0.0015	15	0.0003	3	0.0045	45	0.0055	55
Buffen 30	0.0006	6	0.00008	0.8	0.002	20	0.003	30
Butrol	0.002	20	0.0002	2	0.0045	45	0.003	30
Butyl parasept	0.015	150	0.008	80	>0.30	>3000	0.025	250
Caso-cide (Permacide AM10)	0.004[a]	40[a, d]	0.0015[a, d]	15[a, d]	>0.3[a, d]	>3000	0.08	800
Cetylpyridinum bromide	0.055	550	0.0007	7	>0.30	>3000	>0.30	>3000
Chloroben	>0.30	>3000	0.007	70	>0.30	>3000	>0.30	>3000
2-Chloromercuri-thiophene	0.00003	0.3	0.00002	0.2	0.003	30	0.0015	15
4-Chlororesorcin	0.07	700	0.05	500	0.25	2500	0.15	1500
Copper 3-phenylsalicylate	0.055	550	0.015	150	0.045	450	0.04	400
Copper pentachlorophenate	0.035	350	0.0003	3	0.0025	25	0.0045	45
DHAS	>0.3	>3000	>0 3	>3000	0.045	450	0.035	350
Dowicide A	0.02	200	0.02	200	0.015	150	0.015	150
Dowicide B	0.002	20	0.0015	15	0.0015	15	0.0007	7
Dowicide C	0.006	60	0.003	30	0.0055	55	0.003	30
Dowicide D	0.0045	45	0.002	20	0.0065	65	0.005	50
Dowicide E	0.006	60	0.0015	15	0.015	150	0.008	80
Dowicide F	0.04	400	0.0007	7	0.002	20	0.003	30
Dowicide G	0.02	200	0.0004	4	0.0025	25	0.003	30
Dowicide H	0.02	200	0.0008	8	0.002	20	0.003	30
Dowicide S	0.0085[a, d]	85	0.0015	15	0.003	30	0.0045	45
Dowicide 31	0.004	40	0.0025	25	0.0035	35	0.0035	35
Drew liquid slime control	0.001	10	0.0002	2	0.003	30	0.0035	35
Drew Powder	0.0002	2	0.00003	0.3	0.0006	6	0.0004	4
Dyncide	0.0015	15	0.003	3	0.0065	65	0.007	70
Emulsept E607 Special	0.04[a, d]	400[a, d]	0.014[a, d]	140[a, d]	>0.3	>3000	>0.3	>3000
Fungicide 974	0.005	50	0.002	20	0.0085	85	0.0045	45
G-4	0.0025	25	0.0002	2	0.02	200	0.02	200
Gallicide	0.002	20	0.0004	4	0.015	150	0.015	150
Lignasan	0.001[b]	10[b]	0.00016[b]	1.6[b]	0.004	40	0.0015	15
Merfenel	0.0001[b]	1[b]	0.00001[b]	0.1[b]	0.0004	4	0.0004	4
Mersynate	0.002	20	0.0006	6	0.002	2	0.002	2
Monobutyl *m*-cresol	0.015	150	0.005	50	0.04	400	0.03	300
Nacconol FSNO	>0.20[a]	>2000[a]	0.0018[a]	18[a]	0.11[a]	1100[a]	.....	....
Nalco 21	0.075[b]	750[b]	0.0008[b]	8[b]	0.20	2000	0.095	95
Nalco 21S	0.0025	25	0.0005	5	0.0035	35	0.0055	55
Nalco 21M	0.02	200	0.0005	5	0.0045	45	0.004	40
Nalco 23	0.045[b]	450	0.001[b]	10[b]	0.0035	35	0.004	40
Nytron	>0.30	>3000	0.015	150	>0.30	>3000	>0.30	....
Ottacide	0.008	80	0.002	20	0.003	30	0.005	50
Ottafect	0.0035	35	0.0006	6	0.0095	95	0.0075	75
Ottasept 430	0.025	250	0.004	40	0.006	60	0.0045	45
Penn Salt C.A.F.	0.20	2000	0.25	2500	0.20	2000	0.25	2500
Penetox	0.05[b]	500[b]	0.003[b]	30[b]	>0.30	>3000	>0.30	>3000
Permatox 1S	0.0035[b]	35[b]	0.00018[b]	1.8[b]	0.0035	35	0.003	30
Phymer	0.005	50	0.002	20	>0.30	>3000	>0.3	>3000
PMA	0.0003	3	0.00004	0.4	0.0007	7	0.0009	9
PMAS	0.0009	9	0.00007	0.7	0.0045	45	0.0045	45
P.M. 32 Powder	0.0014	14	0.00014	1.4	0.006	60	0.0055	55
P1006	>0.30	>3000	>0.30	>3000	>0.30	>3000	>0.30	>3000
P200A	0.0035	35	0.0005	5	0.005	50	0.0055	55
Preventol GD	0.002	20	0.0002	2	0.015	150	0.015	150
Preventol GDS	0.0045	45	0.0005	5	0.03	300	0.03	300
Purasan AD	0.0065	65	0.0006	6	>0.30	>3000	>0.30	>3000
Purasan DC	0.07	700	0.0003	3	>0.30	>3000	>0.30	>3000
Purasan X-3	0.055	550	0.0004	4	>0.30	>3000	>0.30	>3000
Puratized 300	0.0025	25	0.0015	15	0.25	2500	0.30	3000
Puratized 641	0.0035	35	0.0002	2	0.004	40	0.0035	35
Puratized F	0.0008	8	0.0002	2	0.0025	25	0.003	30
Puratized N5DS	0.0015	15	0.0001	1	0.0035	35	0.0045	45
Puratized N5E	0.002	20	0.004	4	0.0065	65	0.007	70
Puratized SC	0.0006	6	0.0003	3	0.0006	6	0.0006	6
Pyridylmercuric acetate	0.0001[a]	1[a]	0.000015[a]	0.15[a]	0.0095	95	0.0025	25
Pyridylmercuric chloride	0.0001[a]	1[a]	0.000015[a]	0.15[a]	0.0095	95	0.002	25
Ramplex C 106	0.0023[a, d]	23[a, d]	0.0004[a, d]	4[a, d]	0.004[a, d]	40[a, d]	.....	....
Roccal	0.02[a, d]	200[a, d]	0.0007	7[a, d]	>0.30	>3000	>0.30	>3000
Rosin-Amine D Acetate	0.003	30	0.0015	15	0.30	3000	0.30	3000
RD 1652	0.30	3000	0.025	250	>0.30	>3000	>0.30	>3000
Santobrite	0.0225[b]	225[b]	0.0004[b]	4[b]	0.0035	35	0.003	30
Santophen 1	0.0055	55	0.0015	5	0.008	80	0.008	80
SC 100	0.001	10	0.0001	1	0.001	10	0.007	70
SC 200	0.0003	3	0.00005	0.5	0.0004	4	0.0005	5

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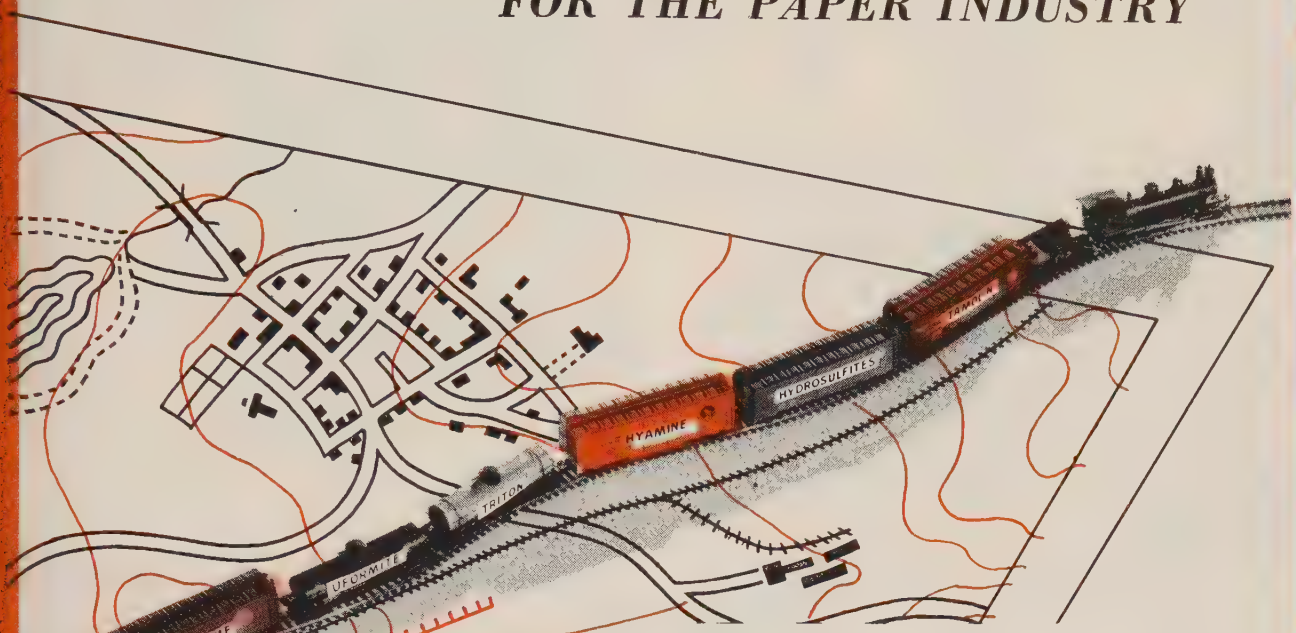

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Table I. The Relative Toxicity of Various Materials to *Aerobacter aerogenes, Bacillus mycoides, Aspergillus niger, and Penicillium expansum* (Continued)

Trade name of disinfectant	Inhibiting concentrations: *Aerobacter aerogenes* Per cent by weight	*Aerobacter aerogenes* P.P.M.	*Bacillus mycoides* Per cent by weight	*Bacillus mycoides* P.P.M.	*Aspergillus niger* Per cent by weight	*Aspergillus niger* P.P.M.	*Penicillium expansum* Per cent by weight	*Penicillium expansum* P.P.M.
Slime-Acide L.M.	0.0003	3	0.00005	0.5	0.0015	15	0.003	30
Slime-Acide M	0.0001[c]	1[c]	0.00003[c]	0.3[c]	0.0002[c]	2[c]	.....	....
Slimicide MSC	0.006	60	0.004	40	>0.30	>3000	>0.30	>3000
2,4,6-Trichloro-resorcinol	0.003	30	0.0015	15	0.015	150	0.01	100
Tween 80	>0.30	>3000	>0.30	>3000	>0.30	>3000	>0.30	>3000
Tyrothricin	>0.30	>3000	0.002	20	>0.30	>3000	>0.30	>3000
USF 188	0.035	350	0.02	200	0.04	400	0.04	40
Vancide 32	0.095	950	0.04	400	0.055	550	0.08	800

[a] Data from Appling, J. W., and McCoy, J. F., "Relative Toxicity of Disinfectants Recommended for Use in the Paper Industry. III. Inhibiting Concentrations of Additional Disinfectants for *Aerobacter aerogenes, Bacillus mycoides,* and *Aspergillus niger.*" *Paper Trade J.* 121, No. 19: 29-32 (1945).
[b] Data from Appling, J. W., and McCoy, J. F., "Relative Toxicity of Disinfectants Recommended for Use in the Paper Industry. II. Inhibiting Concentrations for *Bacillus mycoides* and *Aspergillus niger.*" *Paper Trade J.* 121, No. 3: 37-40 (1945).
[c] The Institute of Paper Chemistry, Unpublished data.
[d] Inhibiting concentration expressed as percentage by volume since these are liquids.

of *Aerobacter aerogenes* was originally obtained from the University of California. The sporeforming bacterium *Bacillus mycoides* was selected as the other species of bacteria because of its frequency in pulp and paper mill systems and also because of its ability to withstand the lethal effect of the drier rolls. This particular strain of *Bacillus mycoides* was isolated from paperboard. The two species of fungi selected as test organisms were *Aspergillus niger* and *Penicillium expansum.* These species were selected because they are commonly found in pulp and paper mill systems and are frequently isolated from the surface of finished paper and from wet lap pulp. These four test organisms are maintained in The Institute of Paper Chemistry's stock culture collection. The bacteria are preserved by the lyophyle process and the fungi are preserved under mineral oil.

The test methods used in evaluating the relative toxicity of the various disinfectants is a modification of the method used in the previous reports on the relative toxicity of disinfectants recommended for use in the paper industry (*1, 4*).

The modified Petri plate method used in this study is as follows: in the case of the bacteria (*Aerobacter aerogenes* and *Bacillus mycoides*) Bacto Nutrient agar is the nutrient medium whereas, for the fungi, *Aspergillus niger* and *Penicillium expansum*, 1.5% malt agar (plain Trommers diastic extract of malt) is the nutrient substrate. The two media are prepared according to the procedure prescribed for the preparation of such media. Prior to sterilization, approximately 80 ml. of the melted medium is dispensed into weighed 150-ml. square Pyrex dilution bottles. After sterilization in an autoclave at 15 p.s.i. for 20 min., the medium is allowed to cool. Before the medium is used in the test, the bottle containing the sterile nutrient substrate is weighed. This eliminates the error of the loss of moisture from the medium during sterilization and during any subsequent reheating. To the cooled melted medium (50 to 55°C.) is added the required amount of the material under investigation to give the desired concentration. That is, proper aliquots of the proper solution of the toxicant are added to the sterile medium to give the desired concentration of the toxicant as expressed in percentage by weight. In some cases, it is necessary to first dissolve the material in a suitable solvent such as alcohol. In all cases where a solvent was used (other than distilled water) to dissolve the toxicant, the effect of the highest concentration of the solvent used was determined for each organism. In no case was there any apparent effect of this concentration of the solvent on the growth of the test organisms. In all cases, an equivalent amount of the nutrient substrate is pipetted aseptically from the Pyrex dilution bottle to compensate for the addition of the toxicant. Immediately after the addition of the toxicant, the bottle is shaken thoroughly to insure proper mixing of the material with the nutrient substrate. After the contents of the Pyrex bottle are mixed, the mixture is distributed equally into three 100-mm. Petri dishes. The agar in the dishes is allowed to harden at room temperature for approximately 2 hr. before inoculation.

The bacterial and fungus inoculum is prepared just before the nutrient substrate is to be inoculated. The bacterial suspension for the test organism *Aerobacter aerogenes* is prepared from a 24-hr. bottle slant of the organism grown at 37° C., whereas the bacterial suspension for the test organism *Bacillus mycoides* is prepared from a 72-hr. bottle slant of the organism grown at 37 °C. (the bottle slant is made by slanting approximately 20 ml. of Difco Nutrient agar in an 8-oz. square Pyrex dilution bottle). The entire growth on the surface of the nutrient agar is aseptically washed into a dilution bottle containing 100 ml. of sterile water.

Each poured plate is inoculated by streaking separately two loopfuls of the bacterial suspension on the surface of the solidified medium. The diameter of the inoculating loop is 3 mm. After streaking, the plates are inverted and placed in an incubator maintained at 37 °C. A preliminary examination is usually made after 24 hr. of incubation and final observations are made after 48 hr. of incubation. The concentration at which no growth occurs is considered as the point of inhibition.

The fungus inoculum is obtained by cutting aseptically uniform circular disks (6 mm. in diameter) from the periphery of a culture of the test organism. The test fungi are grown in Petri dishes on 1.5% malt agar for 14 days. One disk of the fungus inoculum is placed aseptically in the center of the Petri dish with the spore mycelial side in contact with the nutrient substrate. After the malt agar containing the material under test is inoculated, the Petri dishes are placed in an incubator maintained at 28 °C. Final observations on the growth of the test organisms are made after 14 days of incubation.

For each test the sensitivity of each test organism is checked with a highly purified grade of phenylmercuric acetate. If, for some reason, the sensitivity of the test organism has changed, the trial is discarded. The re-

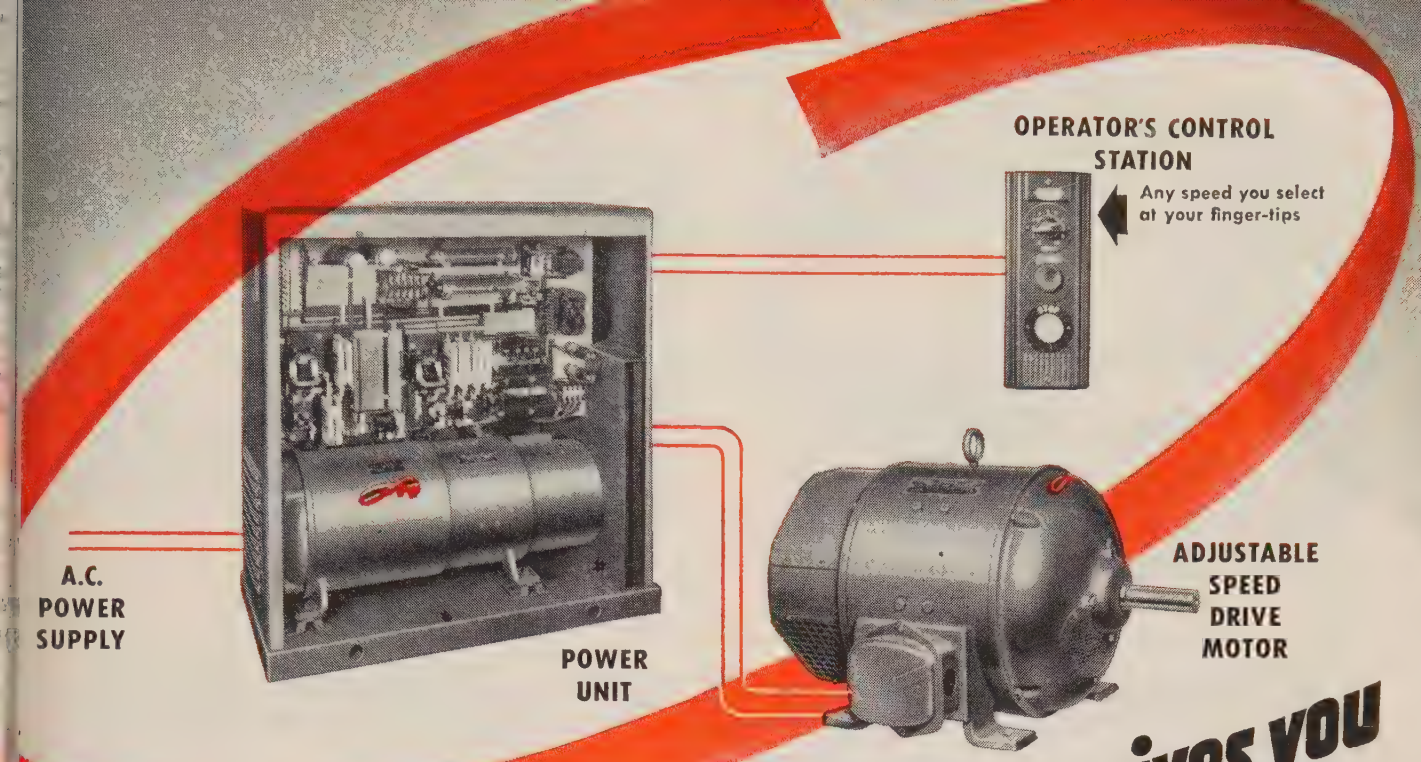

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Table II. The Active Ingredients and the Supplier of the Various Materials Evaluated for Their Relative Toxicity to Two Species of Bacteria and Two Species of Fungi (*Continued*)

Trade name of disinfectant	*Active ingredient*	*Supplier*
Arquad 2C	Dilauryldimethylammonium chloride	Armour and Co.
Arquad 2C Oleate	Dilauryldimethylammonium oleate	Armour and Co.
Arquad 12	Dodecyltrimethylammonium chloride	Armour and Co.
Arquad 18	Octadecyltrimethylammonium chloride	Armour and Co.
Arquad S	Trimethylammonium chloride	Armour and Co.
ATM-50	*N*-alkylbenzyl-*N*,*N*,*N*-trimethylammonium chloride	Orinite Chemical Co.
ATM-X3	Unknown	Orinite Chemical Co.
Benochlor 3C	Similar to chloroben	The Chloroben Corp.
Benzyl parasept	Benzyl ester of *p*-hydroxybenzoic acid	Heyden Chemical Co.
Bionol A	Mixture of alkyl-9-methyl-benzylammonium chlorides	General Dyestuff Corp.
BSM-11	Phenylmercuric compounds plus alkali metal chlorophenates	Buckman Laboratories, Inc.
BSM 11B	Phenylmercuric acetate	Buckman Laboratories, Inc.
Buffen 30	Phenylmercuric acetate	Buckman Laboratories, Inc.
Butrol	Phenylmercuric compounds plus alkali metal *o*-phenylphenates	Buckman Laboratories, Inc.
Butyl parasept	Butyl ester of *p*-hydroxybenzoic acid	Heyden Chemical Co.
Caso-Cide (Permacide AM10)	Lactoxymercuriphenylammonium lactate	Castle Overton, Inc.
Cetyl pyridinium bromide		Gallowhur Chemical Corp.
Chloroben	Mixture of trichlorobenzene and *o*-dichlorobenzene	The Chloroben Corp.
2-Chloromercurithiophene	. . . . .	Jefferson Chemical Co., Inc.
4-Chlororesorcin	. . . . .	Pennsylvania Coal Products Co.
Copper 3-phenylsalicylate	. . . .	Dow Chemical Co.
Copper pentachlorophenate	. . . . .	Monsanto Chemical Co.
DHAS	Sodium salt of dehydroacetic acid	Dow Chemical Co.
Dowicide A	Sodium salt of *o*-phenylphenol	Dow Chemical Co.
Dowicide B	Sodium salt of 2,4,5-trichlorophenol	Dow Chemical Co.
Dowicide C	Sodium salt of chloro-2-phenylphenol	Dow Chemical Co.
Dowicide D	Sodium salt of 2-chloro-4-phenylphenol	Dow Chemical Co.
Dowicide E	Sodium salt of 2-bromo-4-phenylphenol	Dow Chemical Co.
Dowicide F	Sodium salt of 2,3,4,6-tetrachlorophenol	Dow Chemical Co.
Dowicide G	Sodium salt of pentachlorophenol	Dow Chemical Co.
Dowicide H	Unknown	Dow Chemical Co.
Dowicide S	Sodium salts of 2-chloro-6-phenylphenol and 2,3,-4,6-tetrachlorophenol	Dow Chemical Co.
Dowicide 31	Chloro-*o*-phenylphenol	Dow Chemical Co.
Drew Liquid Slime Control	Phenylmercuric compound dissolved in glycolic acid and other solvents	E. F. Drew & Co.
Drew Powder	Unknown	E. F. Drew & Co.
Dynacide	Phenylmercuric acetate and phenylmercuric chloride	William M. Stieh & Co.
Emulsept E 607 Special	*N*(acyl colaminoformylmethyl)pyridinium chloride	Merchants Chemical Co
Fungicide 974 (CRAG)	3,5-Dimethyltetrahydro-1,3,5,2-H-thiodiazine-2-thione	Carbon and Carbide Chemicals Corp.
G-4	2,2′-dihydroxy-5,5′-dichlorodiphenylmethane	Givauden Flavors, Inc.
Gallicide	Phenylmercuric monoethanolammonium acetate	General Dyestuff Corp.
Lignasan	Ethylmercuric phosphate	E. I. du Pont de Nemours & Co.
Merfenel	Phenylmercuric acetate	R. T. Vanderbilt Co.
Mersynate	Phenylmercuric acetate plus trichlorophenol	Gallowhur Chemical Corp.
Monobutyl m-Cresol	. . . . .	Koppers Co., Inc.
Nacconal FSNO	. . . . .	National Aniline Div., Allied Chemical & Dye Corp.
Nalco 21	. . . . .	National Aluminate Co.
Nalco 21S	Mixture of sodium trichlorophenate and sodium pentachlorophenate	National Aluminate Co.
Nalco 21M	Sodium salt of pentachlorophenol	National Aluminate Co.
Nalco 23	. . . . .	National Aluminate Co.
Nytron	Sulphonated ketones, sulphonated amines, sulphonated alkyl sulphamates, sulphonated alkylidene sulphamates, sulphonated alkylidene sulphamate bisulphite	Solvay Process Co.
Ottacide	Blend of *p*-nitrophenol, *p*-chloro-meta-xylenol, and tetrachlorophenol	Ottawa Chemical Co.
Ottafect	2-*tert*-butyl-4-chloro-5-methylphenol	Ottawa Chemical Co.
Ottasept 430	*p*-chloro-meta-xylenol	Ottawa Chemical Co.
Penn Salt C.A.F.	Copper ammonium fluoride	Pennsylvania Salt Mfg. Co.
Penetox	Unknown	Magnus Chemical Co.
Permatox 1S	Unknown	Chapman & Co., Inc.
Phymer	Unknown	Wood Treating Chemicals Co.
PMA	Phenylmercuric acetate	W. A. Cleary Corp.
PMAS	Phenylmercuric acetate	W. A. Cleary Corp.
PM-32 Powder	Unknown	Falls Chemical Products Co.
P1006	Nonmetallic ketone	Gallowhur Chemical Corp.
P200A	Phenylmercuric acetate	Gallowhur Chemical Corp.
Preventol GD	2,2′-dihydroxy-5,5′-dichlorodiphenylmethane	General Dyestuff Corp.
Preventol GDS	2,2′-dihydroxy-5,5′-dichlorodiphenylmethane	General Dyestuff Corp.
Purasan AD	Alkyldimethylbenzylammonium chlorides	Gallowhur Chemical Corp.
Purasan DC	3,4-dichlorobenzylammonium chlorides	Gallowhur Chemical Corp.
Purasan X-3	. . . . .	Gallowhur Chemical Corp.
Puratized 300	Phenylaminocadmium dilactate	Gallowhur Chemical Corp.
Puratized 641	Phenylmercuric formamide	Gallowhur Chemical Corp.
Puratized F	*p*-aminophenylmercuric acetate in lactic acid	Gallowhur Chemical Corp.
Puratized N5DS	Phenylmercuric trihydroxyethylammonium lactate	Gallowhur Chemical Corp.

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Table II. The Active Ingredients and the Supplier of the Various Materials Evaluated for Their Relative Toxicity to Two Species of Bacteria and Two Species of Fungi (*Continued*)

Trade name of disinfectant	*Active ingredient*	*Supplier*
Puratized N5E	Phenylmercuric triethanolammonium lactate	Gallowhur Chemical Corp.
Puratized SC	Phenylmercuric lactate	Gallowhur Chemical Corp.
Pyridylmercuric acetate	. . . . .	Mallinckrodt Chemical Works
Pyridylmercuric chloride	. . . . .	Mallinckrodt Chemical Works
Ramplex C 106	Unknown	Merchants Chemical Co.
Roccal	Mixture of alkyldimethylbenzylammonium chlorides	Winthrop Chemical Co., Inc.
Rosin Amine D acetate	. . . . .	Hercules Powder Co.
RD 1652	Na salt of didodecyldithiocarbamic acid	Armour and Co.
Santobrite	Na salt of pentachlorophenol	Monsanto Chemical Co.
Santophen 1	*o*-benzyl-*p*-chlorophenol	Monsanto Chemical Co.
SC 100	Phenylmercuric acetate	Stecker Chemical, Inc.
SC 200	Phenylmercuric acetate	Stecker Chemical, Inc.
Slime-Acide L.M.	Quaternary ammonium organomercurial complex	Johaneson Wales & Sparre, Inc.
Slime-Acide M	Phenylmercuric acetate	Johaneson Wales & Sparre, Inc.
Slimicide MSC	Unknown	Wood-Treating Chemicals Co.
2,4,6-Trichlororesorcinol	. . . . .	Pennsylvania Coal Products Co.
Tween 80	Nonionic fatty acid ester of sorbitol	Atlas Powder Co.
Tyrothricin	. . . . .	S. B. Penick & Co.
USF188	Sodium alkyl phenates	United States Fungicide Co.
Vancide 32	β-hydroxyethylpyridinium salt of 2-mercaptobenzothiazole	R. T. Vanderbilt Co.

sistance of the particular strains of the test organism to phenylmercuric acetate is as follows: The growth of *Bacillus mycoides* is normally inhibited at a concentration of 0.000015% by weight (0.15 p.p.m.) and frequently at 0.00001% by weight (0.1 p.p.m.). *Aerobacter aerogenes* is normally inhibited at 0.00015% by weight (1.5 p.p.m.) and frequently at 0.0001% by weight (1.0 p.p.m.). *Aspergillus niger* is normally inhibited at 0.0005% by weight (5.0 p.p.m.) and *Penicillium expansum* is normally inhibited at 0.0007% by weight (7.0 p.p.m.).

The increments of the toxicant in the culture media vary with the resistance of the test organisms. That is, if the organism is inhibited at concentrations below 0.0001% by weight (1 p.p.m.), the increment is 0.000001 % by weight or 0.1 p.p.m. If the organism is inhibited in the 0.0001 to 0.001% (1 to 10 p.p.m.) range, the increment is 0.0001% or 1 p.p.m. In the range from 0.001 to 0.01% (10 to 100 p.p.m.) the increment is 0.0005% (5 p.p.m.) and at concentrations above 0.01% (100 p.p.m.) the increment is 0.005% or 50 p.p.m. If the inhibiting concentration is greater than 0.3% by weight or 3000 p.p.m., the results are reported as such because this concentration would not be practicable under mill-operating conditions.

EXPERIMENTAL RESULTS AND DISCUSSION

Relative toxicity data should be one of the criteria used in the selection of a suitable slime-control agent to be tried in a mill system to control the growth of objectionable forms of microorganisms. However, in selecting the most efficient slime-control agent for a given mill system it is advisable to supplement these data with the toxicity of the most effective materials to the microorganisms indigenous to the particular mill and/or machine system. These data, therefore, indicate the most efficient agent(s) to be used for the control of microorganisms in a given mill system. The effect produced by a given slime-control agent(s) on the microorganisms in the mill system should indicate the proper slime-control agent(s) to be used and the concentration required to inhibit the growth of the undesirable organisms under the conditions existing in the mill system at the time of the test. Thus, with this information it should be possible to plan a treatment regime which should give better microbiological control than an arbitrary selection of a slime-control agent.

Ninety-three materials have been evaluated for their relative toxicity to each of the four test organisms. The results obtained are summarized in Table I. The materials are identified by their trade names rather than the chemical composition. However, the chemical composition of the active ingredient of most of the materials is listed in Table II. Although the same active ingredient may be listed for several materials, it is possible that the active material is not present in the same amount in each case; for example, phenylmercuric acetate is listed as the active ingredient in several materials but the concentration of this active ingredient in these materials may vary from 10 to 95%. Since the solubilizing materials and/or other diluents may vary, the material was tested as it was supplied either by a representative of the pulp and paper industry or by a representative of the manufacturer of the material. Therefore, the relative toxicity data are based on the biological activity of the commercial product rather than on the basis of the amount of the ingredient in the formulation. The manufacturers or formulators of the various materials are given in Table III.

The four test organisms used in this study varied in their resistance to the materials tested. In general, the two species of fungi were the most resistant organisms, whereas *Bacillus mycoides* was the most sensitive organism.

The slime-control agents evaluated for their relative toxicity can be placed into five major groups: (1) The organomercurials, (2) chlorinated phenols, (3) miscellaneous organic compounds, (4) quaternary ammonium compounds, and (5) various combinations of these materials. In general, the organomercurials and combinations containing them are the most toxic to the test organism under the condition of this test. The quaternary ammonium compounds tested were relatively ineffective in inhibiting the growth of the test organisms. Therefore, it does not seem likely that this type of com-

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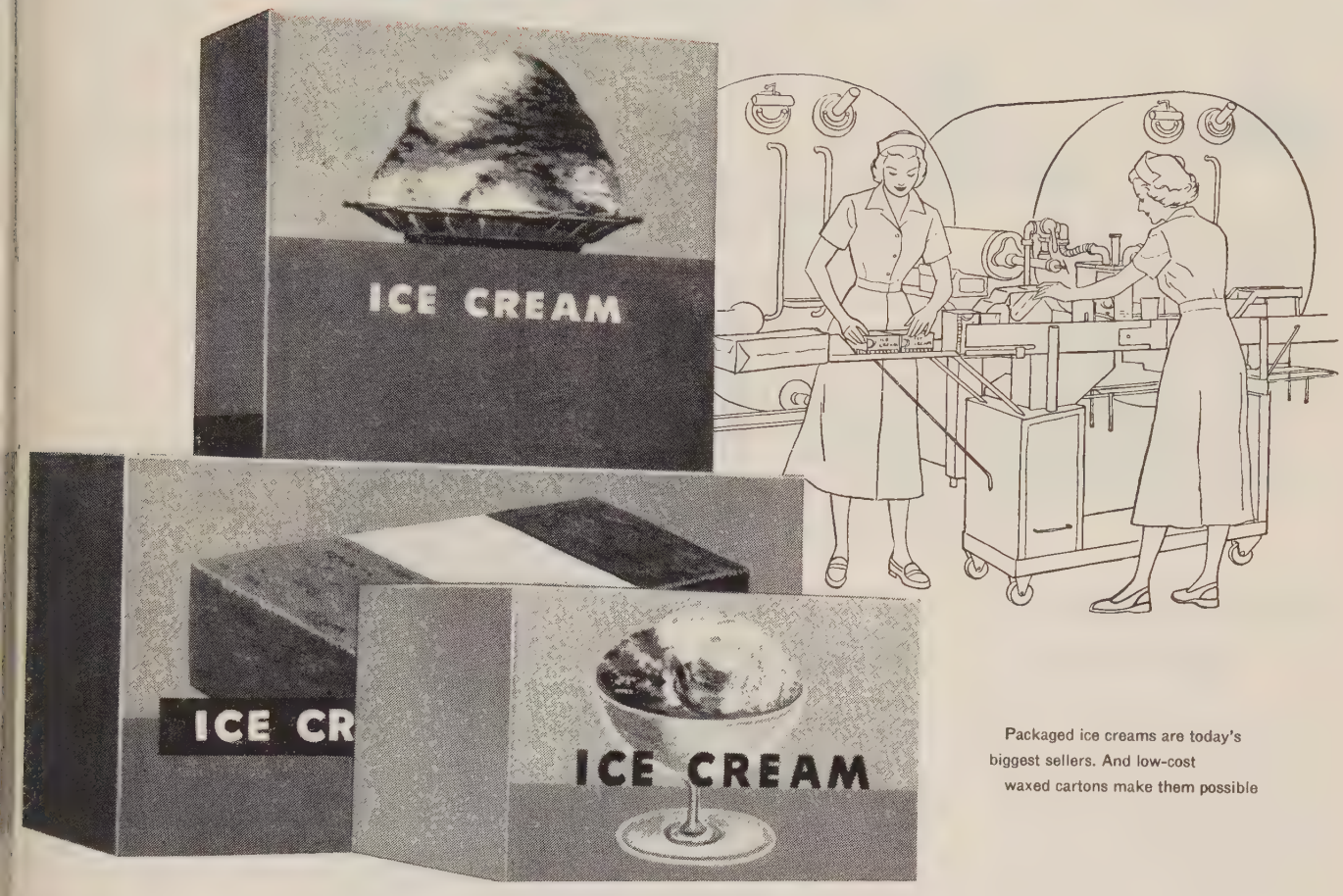

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Three people are most interested in the quality of waxed paper products you turn out: you, your customer, and your competitor. And chances are, they'll all know it if you use anything but the one right wax for the job.

That's why your product can stand a better chance for success when you choose your wax from the broad Atlantic line. Because Atlantic waxes are fully refined waxes—available in a wide range of hardnesses and melting points. They're thoroughly diversified, and one of them is just right for your needs . . . to give you the exact results you want, and the greatest real economy.

You can have delivery of Atlantic waxes in slabs, cartons, pallets, in tank cars or bulk haulers. Get complete information by sending coupon . . . or contact one of the offices listed.

THE ATLANTIC REFINING COMPANY
260 South Broad St., Phila. 1, Pa.

Please send me information on the wax you recommend for use in the manufacture of:

- ☐ Barrel linings
- ☐ Bread wrappers
- ☐ Building papers
- ☐ Butcher's paper
- ☐ Candles
- ☐ Candy wrappers
- ☐ Cartons, butter
- ☐ Cartons, frozen food
- ☐ Cartons, ice cream
- ☐ Chewing gum
- ☐ Crayons
- ☐ Drinking cups
- ☐ Electric insulation coating
- ☐ Fabric sizing
- ☐ Fiber plates
- ☐ Florist paper
- ☐ Fruit wrappers
- ☐ Fruit and vegetable coating
- ☐ Kitchen rolls
- ☐ Kraft bags
- ☐ Match wax
- ☐ Milk bottle caps
- ☐ Milk cartons
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Name _____

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City _____ *State* _____

PROVIDENCE, R. I. 430 Hospital Trust Building
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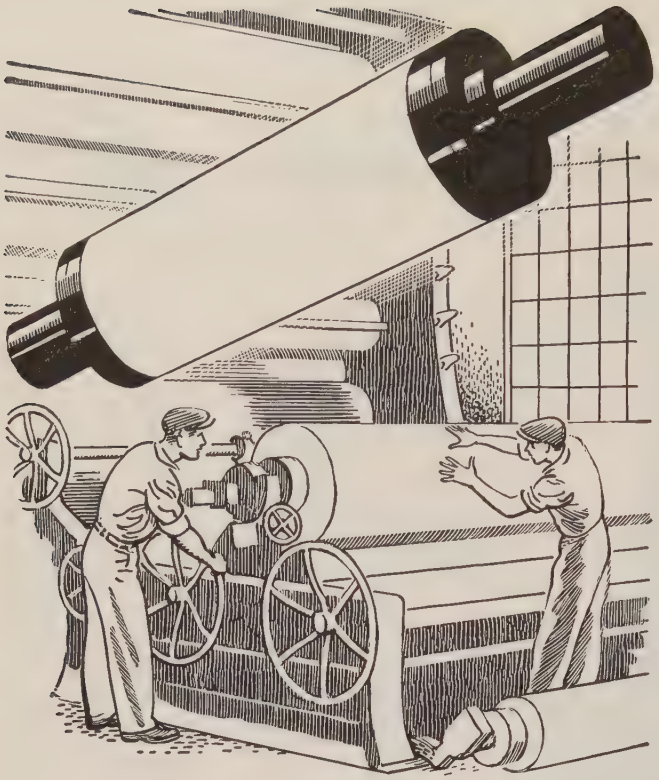

Last Chance For First Quality

Your calender stacks are your final chance for top quality. That's where Butterworth Calender Rolls give you the smooth, uniform finish that is the hallmark of a quality sheet.

Make this simple test. Place one Butterworth Calender Roll in your stack with any other roll or set of rolls. Compare its uniform high-quality calendering. Then check the extra hours of trouble-free service, without requiring turning down or refilling.

Pre-tested for hardness, smoothness and density, Butterworth Calender Rolls are furnished new or refilled for every calendering need — coated, super, glassine, embossing. Let us quote on your requirements.

For full information, write or call H. W. Butterworth & Sons Company, Bethayres, Pennsylvania – 187 Westminster Street, Providence, R. I. : : 1211 Johnston Building, Charlotte, N. C.

Butterworth
CALENDER ROLLS

Table III. Names and Addresses of Manufacturers and/or Formulators of the Disinfectants Included in this Study

Armour and Co., 1355 W. 31st., Chicago 9, Ill.
Atlas Powder Co., Industrial Chemical Dept., Wilmington 99, Del.
Buckman Laboratories, Inc., Memphis 8, Tenn.
Carbon and Carbide Chemicals Corp., 30 E. 42nd St., New York 17, N. Y.
Castle Overton, Inc., 630 Fifth Ave., Rockefeller Center, New York, N. Y.
Chapman & Co., Inc., Chicago, Ill.
The Chloroben Corp., Jersey City, N. J.
W. A. Cleary Corp., 254 W. 31st St., New York 1, N. Y.
Dow Chemical Co., Midland, Mich.
E. F. Drew & Co., Inc., 15 E. 26th St., New York 10, N. Y.
E. I. du Pont de Nemours & Co., Grasselli Chemicals Dept., Wilmington, Del.
Falls Chemical Products Co., Oconto Falls, Wis.
Gallowhur Chemical Co., 801 Second Ave., New York 17, N. Y.
General Dyestuff Corp., 435 Hudson St., New York 14, N. Y.
Givauden Flavors, Inc., 330 W. 42nd St., New York 18, N. Y.
Hercules Powder Co., Naval Stores Dept., Wilmington, Del.
Heyden Chemical Co., Garfield, N. J.
Jefferson Chemical Co., Inc., 711 Fifth Ave., New York 22, N. Y.
Johaneson Wales & Sparre, Inc., 250 Park Ave., New York 17, N. Y.
Koppers Co., Inc., Koppers Building, Pittsburgh 19, Pa.
Magnus Chemical Co., 104 South Ave., Garwood, N. J.
Mallinckrodt Chemical Works, Second and Mallinckrodt Sts., St. Louis 7, Mo.
Merchants Chemical Co., Tribune Tower, Chicago 11, Ill.
Monsanto Chemical Co., St. Louis 4, Mo.
National Aluminate Corp., 6216 W. 66th Place, Chicago 38, Ill.
National Aniline Div., Allied Chemical and Dye Corp., 40 Rector St., New York, N. Y.
Orinite Chemical Co., 38 Sansome St., San Francisco, Calif.
The Ottawa Chemical Co., 819–823 Hamilton St., Toledo 7,
Ohio Pennsylvania Coal Products Co., Petrolia, Pa.
Pennsylvania Salt Mfg. Co., 1000 Widener Building, Philadelphia 7, Pa.
S. B. Penick & Co., 50 Church St., New York 7, N. Y.
Solvay Process Co., Syracuse 1, N. Y.
Stecker Chemical, Inc., Ridgewood, N. J.
William M. Stieh & Co., Inc., 20 Vesey St., New York 7, N. Y.
United States Fungicide Co., 254 W. 31st St., New York 1, N. Y.
R. T. Vanderbilt Co., 230 Park Ave., New York 17, N. Y.
Winthrop Chemical Co., Inc., 1450 Broadway, New York 18, N. Y.
Wood Treating Chemicals Co., 5137 Southwest Ave., St. Louis 10, Mo.

pounds would be effective in controlling slime under practical mill conditions.

Although these tests indicate that the organomercurials are the most effective agents, it does not necessarily follow that these materials will be the most effective agents under all mill-operating conditions. It is possible, therefore, for a material which is less toxic to microorganisms to be the most effective agent either on the basis of its initial cost or its ability to inhibit the particular microorganism present in that particular mill system.

LITERATURE CITED

1. Appling, J. W., and Shema, B. F. *Paper Mill News* 65, No. 35: 14, 16 (Aug. 29, 1942).
2. Appling, J. W., and McCoy, J. F. *Paper Trade J.* 119, No. 11: 116–118 (1944).
3. Appling, J. W., and McCoy, J. F. *Paper Trade J.* 121, No. 3: 37–40 (1945).
4. Appling, J. W., and McCoy, J. F. *Paper Trade J.* 121, No. 19: 29–32 (1945).

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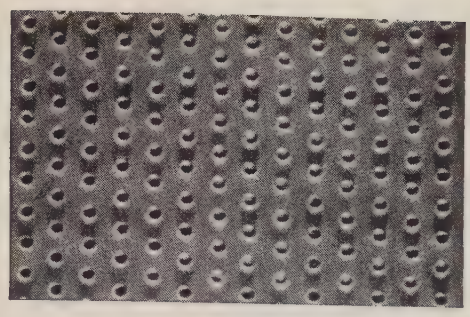
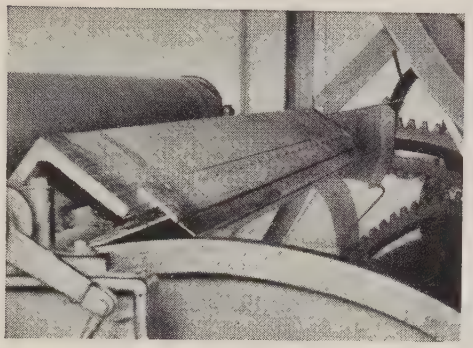
Screen Plates



Efforts to find screen plates with non-enlarging perforations led to trial of thin-gauge Inconel by a Western manufacturer of book groundwood whose plates were corroding beyond use in less than 5 months. This is one of four original plates of .018" Inconel with .045" perforations, photographed after more than 36 months of continuous use. The mill found "no . . . measurable enlargement of the perforations . . ."

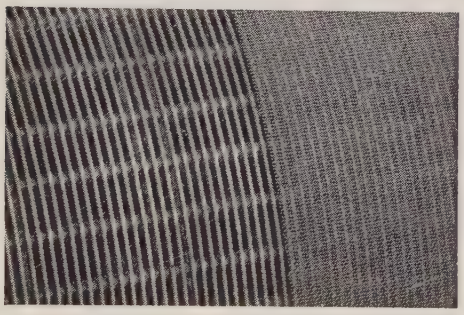
Are replacements costing you TOO MUCH?

Doctor Blades



"K" Monel doctor blades. The mirror-like appearance of the roll itself shows how well the "K" Monel doctor blade on this dryer protects the surface. Even when operated continuously, "K" Monel blades require a minimum of regrinding. Blade surfaces do not rust, and they resist roughening and damage from corrosive paper stocks, sours, cleaners and chemicals.

Winding Wire



Monel winding wire is used over structural rods of cylinders, over drainage strips of drums, and as binding wire over wire cloth faces of filters. Available with a tensile strength as high as 140,000 psi, Monel wire can be wound on its own diameter without fracture. It possesses high resistance to fatigue under corrosive conditions, gives from 2 to 15 times the service obtained from other materials.

You can be sure of this. Frequent replacements always cost too much.

For frequent replacements can be avoided.

You find that out when you use Inco Nickel Alloys like Monel®, "K"® Monel and Inconel®. They last longer (and require less maintenance) because they resist corrosion, abrasion and wear.

And you save money in at least three ways. Here's how you figure it:

On every replacement that you *don't* have to make, your first saving is the *price of materials.* Then you save the entire cost of *labor for installation.* And your third saving is the value of *production ordinarily lost* during downtime.

Count your downtime for honing and grinding doctor blades, too. That has to be done periodically, no matter what blade material you use. But "K" Monel runs longer between regrinds, and helps cut downtime to a minimum.

Inco Nickel Alloys hang up excellent performance records on jobs where many materials find the going rough. You can easily prove this. Just try a replacement part of Monel, "K" Monel or Inconel on machines that are hard hit by corrosion and wear. Then watch how they stand up!

If you'd like advice and help in picking the right metal for any corrosive pulp, paper or board mill job, don't hesitate to call on us. And remember, it is advisable to place equipment orders with your supplier well in advance of scheduled use.

Your local Distributor of Inco Nickel Alloys can give you the latest information on availability from warehouse and mill. We'll be glad to send you his address if you don't have it handy.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

Inco Nickel Alloys

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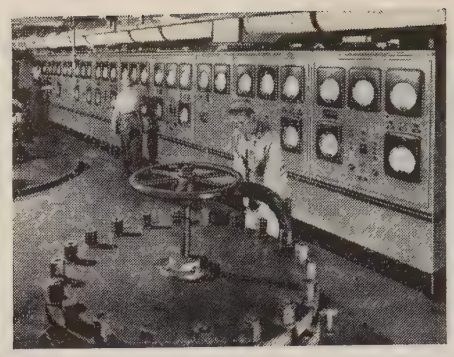
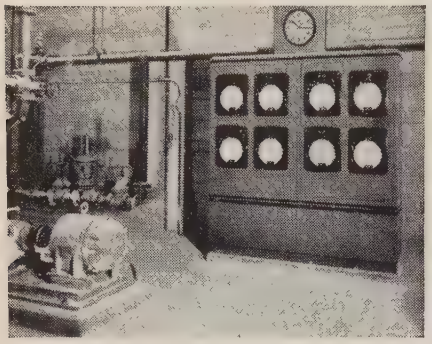
Monel® • "R"® Monel • "K"® Monel • "KR"® Monel • "S"® Monel
Inconel® • Inconel "X"® • Inconel "W"® • Incoloy®
Nimonic® Alloys • Nickel • Low Carbon Nickel • Duranickel®

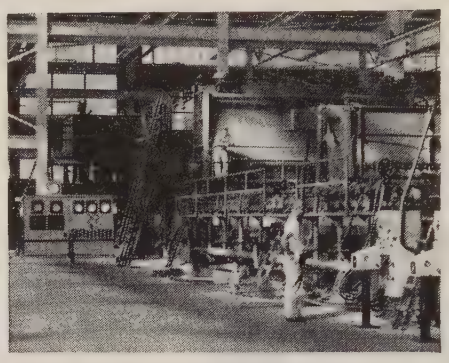
Alkaline Pulp Digester Control
Riegel Carolina Corp.



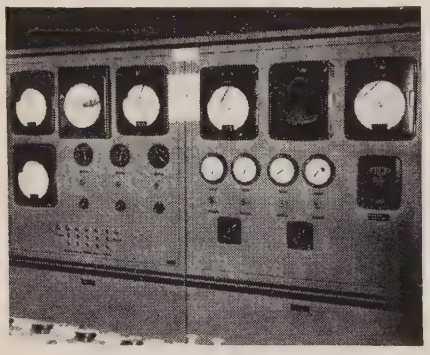
Sulphite Pulp Digester Control
Weyerhaeuser, Pulp Div.



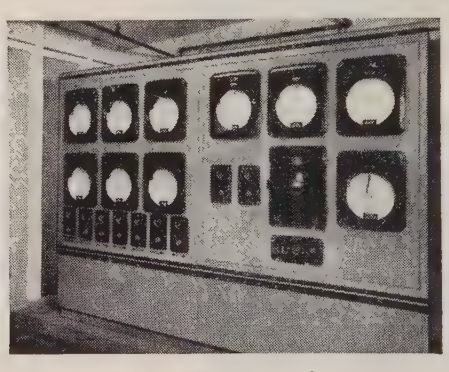
Recausticizing Control
Brown Co.



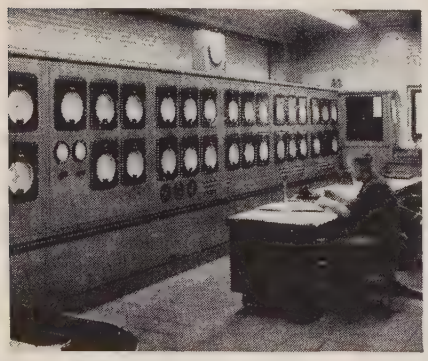
Paper Machine Wet End Control
Southern Paperboard Corp.



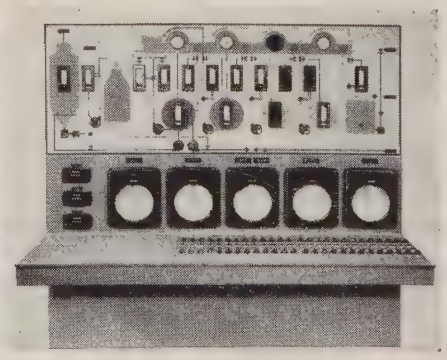
Pulp Drying Control
Riegel Carolina Corp.



Screen Room Control
Brown Co.



Bleach Plant Control
S D Warren Co.



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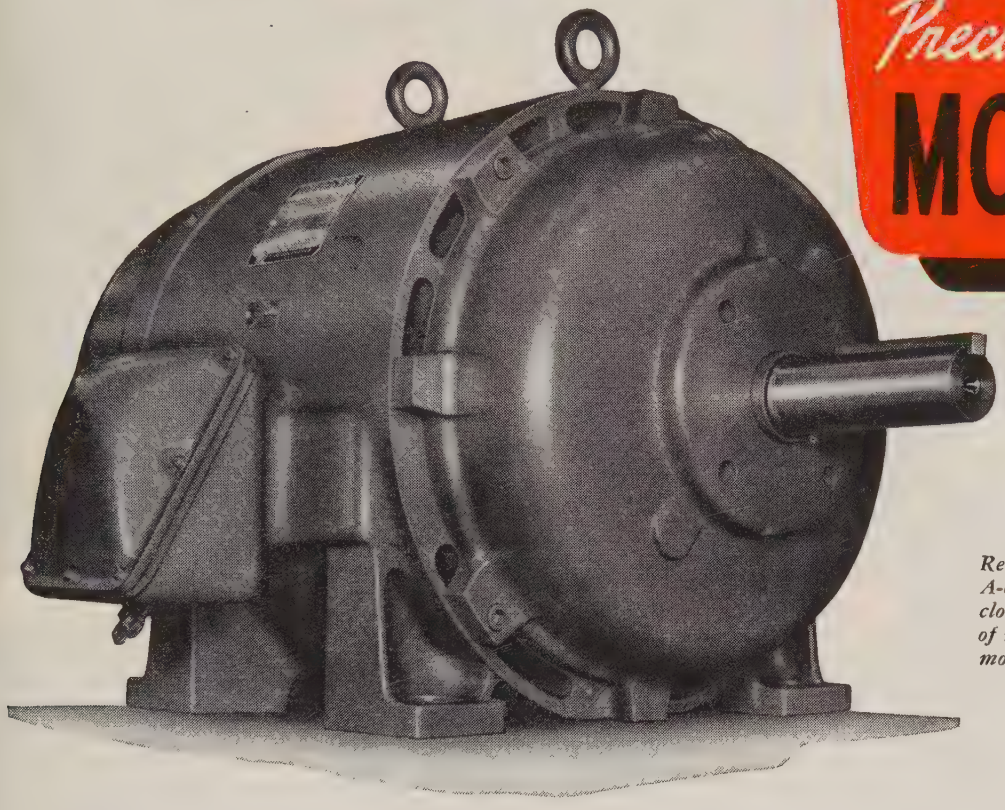

Reliance Totally-enclosed Fan-cooled A-c. Motor. All other standard enclosures available, with wide choice of mechanical designs and special mountings. Ratings from 3/4 to 300 hp.

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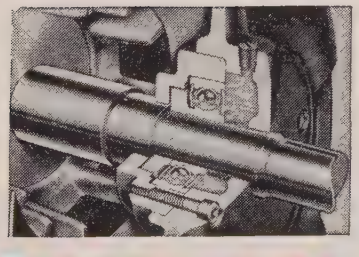

. . . AND THE BEST PRE-LUBRICATED BEARING DESIGN

The Reliance pre-lubricated bearing provides *four times more operating hours without re-lubrication* than any other bearing used in motors today. And—whatever your lubrication schedule—*you just can't grease'em wrong!* To get the complete "inside story" on motor bearings, write today for Bulletin B-2201. It contains hard facts on the advantages of the Reliance pre-lubricated bearing design, with cutaway view, cross-section diagram, comparison chart, and statements by bearing manufacturers. B-1458 J

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Coming up with the *right* pulps for special papers like wallpaper is a job our Technical Service Division has been doing for more than half a century. If you have a paper problem of any kind, perhaps we can help you, too. Write to Dept. PD11 in our Boston office.

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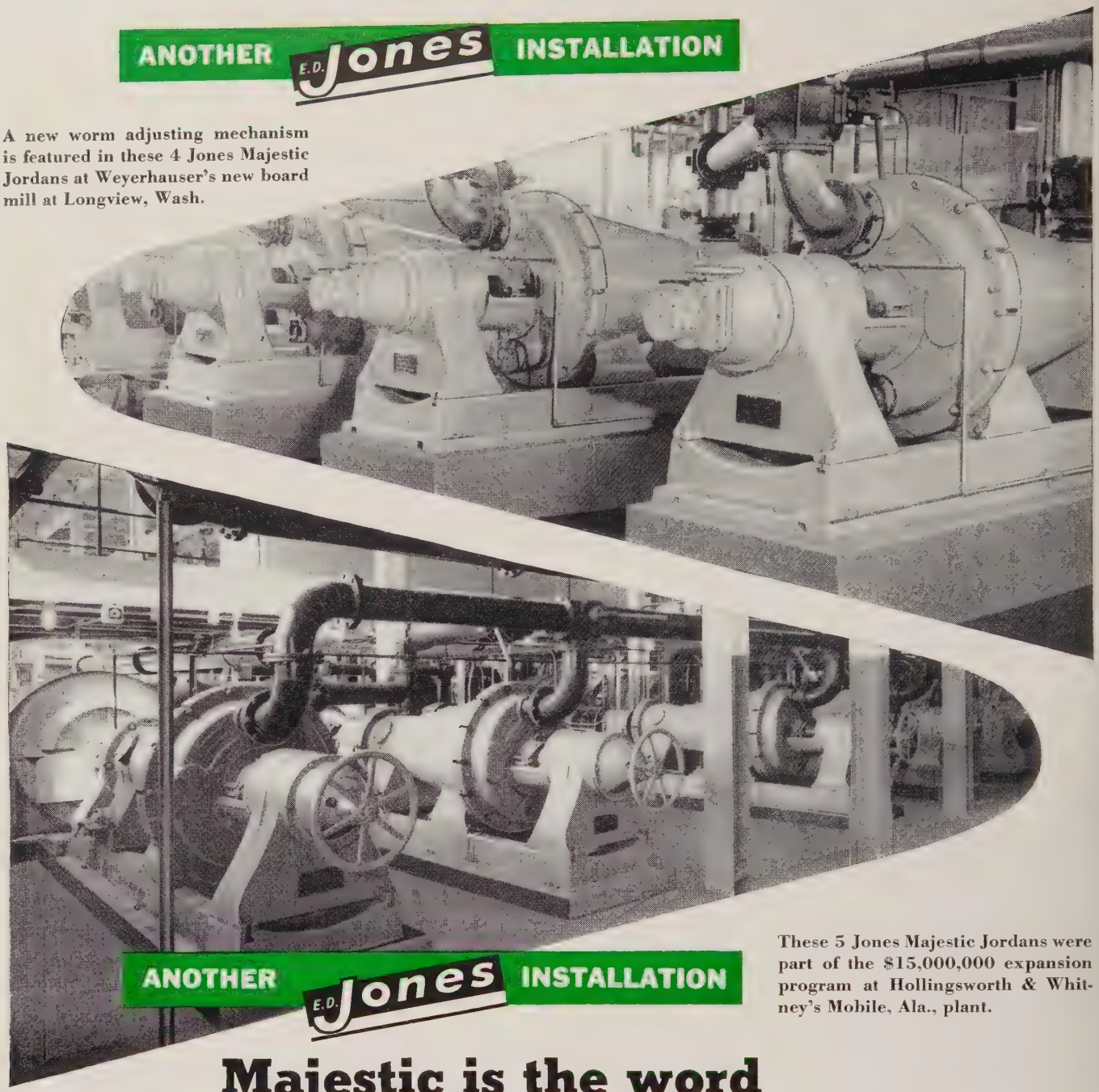
ANOTHER E.D. Jones INSTALLATION

A new worm adjusting mechanism is featured in these 4 Jones Majestic Jordans at Weyerhauser's new board mill at Longview, Wash.



ANOTHER E.D. Jones INSTALLATION

These 5 Jones Majestic Jordans were part of the $15,000,000 expansion program at Hollingsworth & Whitney's Mobile, Ala., plant.

Majestic is the word for these Jordans

The Majestic is only one of the many sizes in which Jones Jordans are made. But such is the popularity of this high-capacity work horse that it accounts for 25% of the Jones Jordans sold to date. Like all Jones Jordans it incorporates exclusive features developed from our more-than-a-century of service to paper mills. For more details, ask your Jones representative or write for Bulletin 1007-A.

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PROOF!

KELSIZE keeps glue line where you need it!

Maximum bond and 100% fibre pull does not depend on excessive penetration as proven by illustration below showing complete fibre pull of pressure sensitive tape whose penetration factor is nil.

1. Stick strip of tape to piece of corrugated paperboard.

2. Lift tape off. Note how surface fibres of paperboard adhere to tape, proving a completely uniform bond has been obtained.

Make this test yourself. Prove that you don't need excessive glue penetration for maximum bond. In fact, only by keeping the glue line at surface do you get maximum bond — with substantial glue savings!

A fraction of a percent of KELSIZE added to your adhesive will control penetration and keep your glue line where you need it.

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REFINED ALGIN PRODUCTS

Progress in Alkaline Pulping—1952*

J. E. STONE and S. D. WELLS

This is a review of the literature dealing with alkaline pulping published during the calendar year 1952. The *Bulletin of the Institute of Paper Chemistry (B.I.P.C.)*, which consists of abstracts from practically all of the scientific and technological journals pertaining to pulp and paper, has been used as the source for most of the references, but a few have been taken from *Chemical Abstracts*. In the latter category are the references to Japanese and Russian work, some of which were published several years prior to 1952 but appeared in *Chemical Abstracts* during 1952.

The scope of this review includes brief mention of expansion in the industry, the pulping of various plant materials, liquor make-up and pulping variables, problems associated with black liquor recovery, odor abatement, stream pollution, and certain aspects of stock preparation where these appear to have some feature characteristic of alkaline pulps. No mention is made of black liquor, tall oil, or turpentine utilization, or of the reactions between carbohydrate and alkali such as those associated with rayon manufacture.

THE INDUSTRY

A discussion of the expansion of the industry in the southern part of the United States is given by Albert (*1*) while that pertaining to Florida is given by Wright (*2*). Particular mills which have received attention are the 200-ton bleached sulphate mill of the Riegel Carolina Corp. at Acme, N. C. (*3*); the new mill of the West Virginia Pulp & Paper Co. at Covington, Va. (*4*); the unbleached kraft mill of the Hudson Pulp & Paper Corp. at Palatka, Fla., which doubles its existing capacity to 400 tons per day (*5*, *5A*); the St. Regis Paper Co.'s mill at Cantonment, Fla. (*6*); the Brunswick Pulp & Paper Co.'s expansion from 290 to 400 tons of bleach sulphate at Brunswick, Ga. (*7*); and the mill of the North Carolina Pulp Co. at Plymouth, N. C. (*8*). In California, the new 250-ton kraft mill of Fiberboard Products at Antioch was described (*9*); the S. D. Warren Co. has expanded its Cumberland mills in Maine from 175 to 240 tons of soda pulp (*10*); and the Groveton Paper Co. has established a new semichemical mill at Groveton, N. H. (*11*). *Chemical Engineering* (*12*) reports on the status in 1952 of a number of expansions and new mills proposed for the United States, including the sulphate and newsprint mill of Bowater Southern Paper, Charleston, Tenn. ($15,000,000); East Texas Pulp & Paper, Jasper County, Tex. ($2,000,000); Everett Pulp & Paper, Everett, Wash. ($2,000,000); the proposed kraft mill of Great Northern Millinocket, Me. ($6,000,000); Procter & Gamble's $20,000,000 mill at Foley, Fla.; Rayonier's mill at Jessup, Ga. ($25,000,000); the $1,350,000 addition to the kraft mill of St. Mary's Kraft, St. Mary's, Ga.; and the $5,600,000 mill of Southern Paperboard Products at Savannah, Ga.

The expansion during the past 5-years of the mill at Atenquique, Mex., was described (*13*), and in Canada, Celanese has disclosed its plans for a $65 million project at Arrow Lakes, B. C. (*14*). This will be designed for 400 tons of bleached and semibleached sulphate pulp. The parchment mill of the KVP Co. at Espanola, Ont., which makes 275 tons per day of kraft pulp from spruce, jackpine, and poplar, has been described (*15*). At Fairville, N. B., a 250-ton bleached kraft mill is being built for the Irving Pulp & Paper Ltd. (*16*).

There has been mention of two mills in France, one at Condat using the soda process on chestnut (*17*), and the other at Fracture using maritime pine to produce 400 tons per month of sulphate dissolving pulp and 4000 tons of kraft wrapping paper (*18*).

In the field of agricultural residues, Kasser (*19*) and Atchison (*20*) discuss the various commercial operations now in existence (soda, kraft, and neutral sulphite) using straw and bagasse. Atchison (*21*) also has dealt with straw pulping developments in the Netherlands (*21*). Particular mills which have received attention are those at Paramonga, Peru, producing 19,000 tons of pulp in 1951 of which 70% was from bagasse (*22*); the mill at Dalmianagar, India, producing 20 tons of bleached pulp per day from bagasse (*23*); the mill at Arnhem in Holland producing 12,000 tons per year of bleached pulp from straw (*24*); and the mill at Radcliffe, England, producing 600 tons of pulp per week from straw (*25*). The last three mills use the Celdecor process.

INSTITUTIONAL RESEARCH PROGRAMS

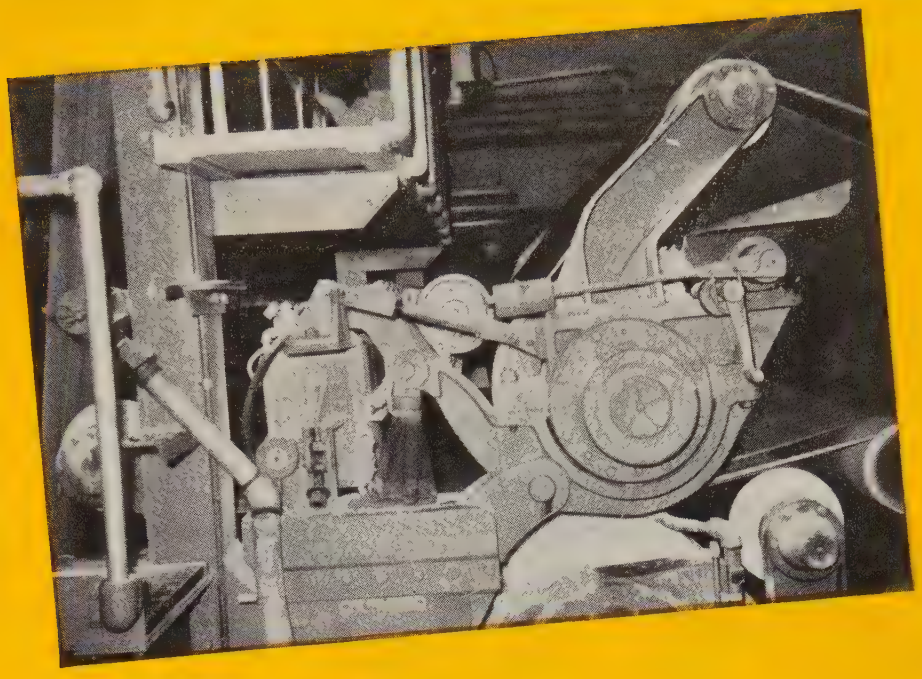
The report of the Committee on Coordination of Research of the American Paper and Pulp Association shows that 36 research institutions are engaged in projects directly related to the manufacture of pulp and paper (*26*). The research programs of the following institutions are briefly outlined: University of Maine Herty Foundation Laboratories, Purdue University, Polytechnic Institute of Brooklyn, Michigan State College, University of Washington, Western Michigan College, Northeastern Wood Utilization Council, College of Forestry, State University of New York, and North Carolina State College. The programs of the University of Florida (*27*), Forest Products Laboratory (*28*), Battelle Institute (*29*), the Northern Regional Research Laboratory (*30*), and The Institute of Paper Chemistry (*31*) are described in more detail. In many cases, the activities of these institutions include a study of alkaline processes.

The activities of the Pulp and Paper Research Insti-

John E. Stone, Research Assistant, and Sidney D. Wells, Research Associate, The Institute of Paper Chemisty, Appleton, Wis.

*Sponsored by the Alkaline Pulping Committee of the Technical Association of the Pulp and Paper Industry, F. W. Bishop, Chairman. The *Southern Pulp and Paper Manufacturer* finances the preparation of this report annually for TAPPI as a service to the pulp, paper, and paperboard manufacturers.

Actual installation of new Puseyjones Watermarking Attachment on upper press roll.



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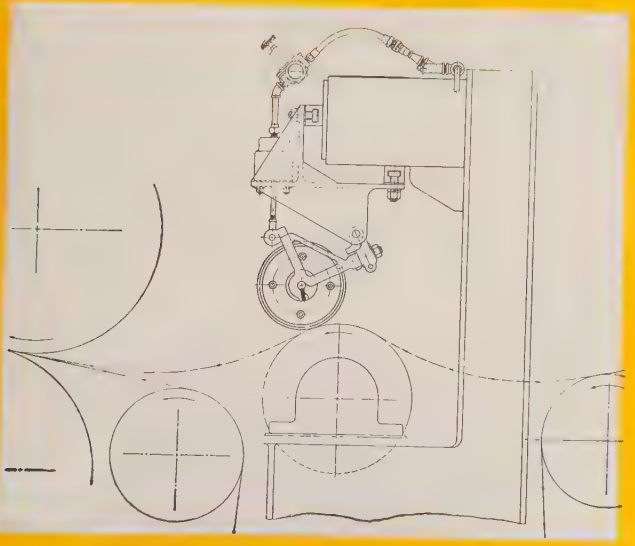
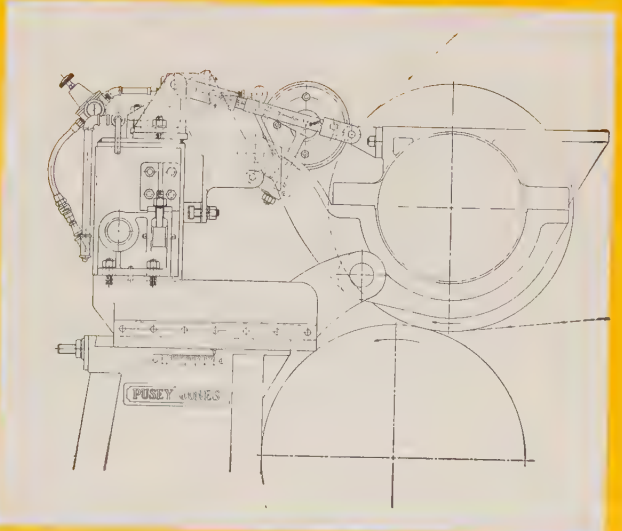


Typical installation on upper press roll.



tute of Canada are described by Maass (*32*), *Canadian Pulp & Paper Industry* (*33*), and Evans (*34*).

The program of the Forest Products Laboratory in England is described by Farmer (*35*); that of the Swiss National Bureau of Standards by Fehrlin (*36*); the Indian work at the Forest Research Institute by Bhat (*37*); and the program of the Norwegian Research Organization by Kiaer (*38*).

The second series of lectures on pulping and papermaking given by the University of Maine is published in the *Paper Trade Journal* (Nov. 14, 1952). They include lectures on kraft pulping by Brainerd (*39*) and Carlin (*40*); soda pulping by Field (*41*) and Morrison (*42*); recovery units by Coulter (*43*) and Owens (*44*); and corrosion-resistant metals by Horigan (*45*).

THE FIBROUS RAW MATERIAL

A considerable variety of wood species, grasses, and agricultural residues have been pulped by the soda and kraft processes and their papermaking properties evaluated.

Bhat (*46*) has presented data on the pulping of *Arundo donax, Phagmites karka,* ulla and panni grasses, castor oil plants, and jute. Bhat and Jaspal (*47*) studied both the annual and perennial varieties of the castor oil plant with a view to producing pulps for writing and printing papers. They found that easy-bleaching pulps can be prepared from either variety by the soda or the kraft process, although the kraft was probably the better—the barks contain long bast fibers and need not be removed from the wood and the strength of the pulps was satisfactory. Bhat and Virmani (*48*) pulped the reedlike perennial grass *Phagmites karka* by both alkaline processes and found that suitable pulps for writing papers could be produced, but they should be mixed with bamboo or sabai grass to increase the percentage of longer fibers. The same workers also studied *Arundo donax* (*49*), They found that a kraft cook for 6 hr. at 153 to 162°C. yielded an easy-bleaching pulp which suggested that it would be a useful papermaking raw material. The soda process gave slightly lower yields. Bhat and Singh (*50*) recommended the use of the large shrub *Helicteres isora* in Indian mills. Both soda and sulphate processes were suitable but the pulps should be mixed with 40% of a long-fibered pulp such as that from sabai grass or bamboo. The same workers (*51*) also studied the lime cooking of ulla and panni grasses for strawboard. With the former, 15% lime at 140°C. or 10% at 162°C. proved satisfactory. With the latter, 10% lime at 162°C. was the most suitable. The deciduous tree *Boswellia serrata* (salai) was pulped by Bhat, Guha, and Panda (*52*) and proved satisfactory if a long-fibered pulp were mixed with it. Bhat and Guha (*53*) obtained a good yield of easy-bleaching pulp from the paper mulberry using the kraft process and they recommended it, providing about 25% of long-fibered pulp, such as that from bamboo, were added. Singh and Guha (*54*) calculated that the cost of pulping illuk grass by the neutral sulphite process was 38% higher than by the soda process. For this material they recommended a fractional or two-stage soda cook. Bhargava (*55*) discussed the methods presently being used in India for pulping bamboo and sabai grass, and after giving reasons for present inefficient practices he made suggestions for their improvement. It is reported by the Indian Government Research Center at Poona (*56*) that excellent kraft paper can be made from banana stumps if 40% of a jute pulp is added. Transport difficulties suggest that it might be most suitable as a cottage industry.

Lauer and Ghoneim (*57*) studied the soda pulping of Egyptian rice straw. Varying the temperature between 60 and 170°C. they found that the maximum lignin removal occurred at 100°C. whereas the alpha-cellulose and hemicellulose content decreased almost linearly with increasing temperature. The lowest ash and silica contents were also rated at 100°C. The maximum fold, burst, and tensile were obtained at 120°C., a marked drop in strength occurring at 140°C. They found that a straight soda cook was more satisfactory than the kraft process. Katsumi (*58*) obtained a Japanese patent for preparing a rice straw pulp by cooking with sodium carbonate.

Chêne and Deissenberg (*59*) gave some of the results of a long series of straw cooks using lime, lime and caustic, lime and sodium carbonate, lime and sulphur, calcium sulphide, sodium hydroxide, sodium sulphide, sodium carbonate, sodium hydroxide and sulphur, sodium sulphite and hydroxide, sodium sulphite and carbonate, calcium sulphite and sodium carbonate and cold 41½% sodium hydroxide.

Cooks with lime alone or with the addition of a little sulphur were also made by Centola, Pancirolli, and Ceragioli (*60*) using esparto, straw, bagasse, papyrus, and banana fiber as raw materials. They found that the effect of the sulphur was to lower the lignin content, giving more easily bleached pulps with better strength. The bad odor, however, would be a serious objection to the use of sulphur. A general outline of the processes for the manufacture of straw pulps by cooking with lime was given by Gianni (*61*).

Chiego (*62*) patented a process for making a pulp additive from corncobs or bagasse. The dried raw material is ground to 5 to 80 mesh, cooked for 30 min. with a 1% caustic solution at 212°F., then washed, bleached, dried, and pulverized. The resulting product, termed "Cellan" is recommended for adding to paper pulp in quantities up to 50%. Okuno obtained a Japanese patent (*63*) for a similar type of product from straw. It was cooked with 5 to 7% sodium sulphite and 3 to 5% sodium hydroxide or carbonate, ground in a ball mill, and added to wood pulp for newsprint.

Another agricultural residue, sorghum stalks, which is available in the Gold Coast, has been pulped by Chittenden, Coomber, and Morton (*64*) to give satisfactory yields of an easily bleached, moderately strong, short-fibered pulp. A fairly severe cook is required, however, and the consumption of caustic is rather high.

Masirevic (*65*) cooked the lower, middle, and upper parts of cornstalks with sodium hydroxide for 5 hr. at the boiling point. The upper part of the plant gave the strongest pulp and was suitable for board and wrapping paper.

Dubois (*66*) investigated the papermaking properties of the common cattail *Typha latifolia*. The heads and stems were cooked at 320°F. for 2 and 3 hr. with 0 to 10% sodium hydroxide and it was found that for the 2-hr. cook, the optimum amount of sodium hydroxide was 2 to 5% which gave a cheap, flexible, brown, weak, and unbleachable paper. With a 3-hr. cook, the paper was brown, strong, and unbleachable.

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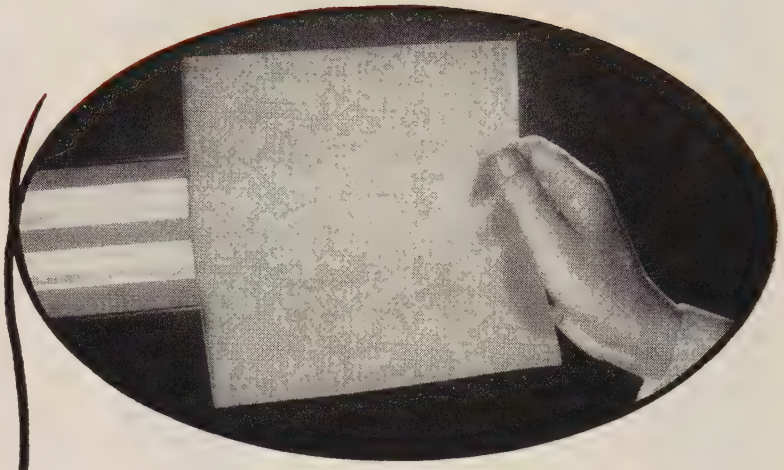

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The production of a viscose pulp from wheat straw was accomplished by Saulquin and Escard (*67*). Using a prehydrolysis with water under pressure to eliminate much of the pentosans, a hot alkaline wash, a chlorination with chlorine gas, a cold alkaline wash, and a hypochlorite bleach, their pulp met the specifications of less than 0.05% silica, less than 4% pentosans, and better than 30% yield of more than 96% alpha-cellulose.

The pulping of rye straw has been studied by Rodziewicz (*68*) using a neutral sulphite process and Rudzka (*69*) using the sulphate process. In the first case, the best results were obtained using sodium sulphite alone with 16.8% based on the straw, a liquor:straw ratio of 6:1, 3 hr. to 170°C., and 2 hr. at 170°C. A good cream-colored pulp was obtained in 59% yield. In the second case, the optimum conditions were 7.4 grams sodium and 0.9 gram hydrogen sulphide per 100 grams of straw, $2^1/_2$ hr. to 150°C., 2 hr. at 150°C. with a liquor:straw ratio of 5:1. The yield was 57.6%

The pulping of "nonlignified" plant material by means of a kraft cook has been described by Gruen (*70*). Yields vary from 43 to 8% depending on the starting material.

French studies on the soda cooking of flax tow to produce pulps for cigarette papers are described by Deissenberg and Delaveau (*71*, *71A*) and Chêne, Deissenberg, and Delaveau (*72*). The best pulps, which were a compromise between a low lignin content and a high D.P., were obtained with 12 to 18% caustic soda at about 150°C. for 5 hr. At 180°C., serious degradation of the pulp occurs.

A symposium on the pulping of tropical woods was held in Appleton, Wis., in 1951. Coomber (*73*) gave the results obtained over the past two decades in the alkaline pulping of hardwoods from British Guiana, British Honduras, Nigeria, Trinidad, South Africa, and Tanganyika. A number of varieties showed considerable promise for making certain grades of paper, but the heterogeneous nature of the forests might be a serious obstacle. He believed that mixed cooks such as those developed by French workers should receive careful consideration. Current work on three British Guiana hardwoods was described by Farmer and Campbell (*74*) while Chittenden, Coomber, and Morton (*75*, *75A*) discussed the pulping of brachystegia wood from Tanganyika. Neutral sulphite, soda, and kraft processes were tried but none of them produced a satisfactory pulp, the fibers being short, the pulp weak, the yields poor, and bleaching difficult. In contrast to this, three Chilean hardwoods—coigue, tepa, and ulmo—were found by Simmonds and Kingsbury (*76*) to give pulp acceptable for rayon production when cooked by a neutral sulphite, acid sulphite, or sulphate procedure.

French work on the pulping of woods from French Colonial Africa was described by Peteri (*77*). He pointed out that methods suitable for softwoods or northern hardwoods are not necessarily suitable for tropical hardwoods. The sulphite process is usually unsuitable, the soda process suitable for certain individual species, but not for mixed species, while the sulphate process gives very good results with any mixture. The superiority of pulps resulting from mixtures of several species was emphasized. Aubreville (*78*) has also dealt with the French work in Africa and stated that in their pilot plant operations, they sometimes use 20 different woods in a mixed cook. Not all mixtures are suitable, however, so that the location of the mill is important. Their findings with mixed woods confirm the work of Runkel (*79*) who has studied the pulping of hardwoods from temperate and tropical zones. With tropical hardwoods, he believes that the acid sulphite process is unsuitable, the soda process is suitable for bleached but unsuitable for unbleached pulps, while the sulphate process is suitable for all grades. If possible, mixed cooks should consist of botanically similar woods with similar densities, to avoid uneven penetration. Niethammer (*80*) discussed the economics of pulping West African woods and stated that, although it would be uneconomic to transport the wood to Europe, a pulp mill constructed in West Africa, especially if on a large scale, appeared feasible from a technical point of view and economically sound.

Australian work on the preparation of dissolving grade celluloses from eucalyptus by the sulphate process was described by Meller (*81*). Indian work on tropical hardwoods was given by Bhat (*46*).

A summary of the papers given at this tropical woods symposium has been made by Lewis (*82*).

Fujinaga (*83*) has studied the production of a high viscosity pulp from uotorimodoki wood, which comes from the Palo Islands. Using $4^1/_2$% sodium hydroxide at 3 atm. pressure at 135°C. for 10 hr. followed by a two-stage bleach, a spinnable pulp was obtained.

Crossley (*84*) found that fine pulps quite suitable for cigarette papers could be made from orchard slash. It was found that a straight soda cook gave the best results, and the long, cottonlike fibers from the bark made it desirable to use both bark and wood. Weimer (*85*) reported that experiments at the Herty Laboratories have shown that pulps from cull hardwoods can be added to standard kraft pulp to give an equal or superior sheet to kraft alone. McGovern (*86*) described the preparation of neutral sulphite semichemical pulps from red alder, old and second-growth Douglas-fir, western red cedar, and western hemlock. He also described the preparation of sulphate semichemical and neutral sulphite semichemical pulps from red alder and Douglas-fir. Corrugating and liner boards of excellent quality were obtained from some of the pulps, while the bleached grades met the commercial requirements for greaseproof and lithograph-type printing papers. McGovern, Martin, and Hyttinen (*87*) studied the effect of storing slash pine on the quality of sulphate pulp made from it, and found that the loss in yield was proportional to the decrease in the wood density. They recommended that fall-cut wood stored in the open should be used within 5 months to avoid loss in strength qualities of the pulp. Martin and Brown (*88*) found that a considerable percentage of bark could be pulped with southern pine, using the kraft process, but its presence caused an increase in the consumption of chemicals and a decrease in brightness.

A comparison of poplar, birch, and beech (alone or in admixture) (with and without bark), using alkaline, neutral, and acid liquors, has been made at the Institut National du Bois in Grenoble and described by Bouchayer and Laurent (*89*). Poplar pulps with the best strength properties were prepared with sodium hydroxide and sulphur. The semichemical work has been described by Bouchayer (*90*), who tabulated the

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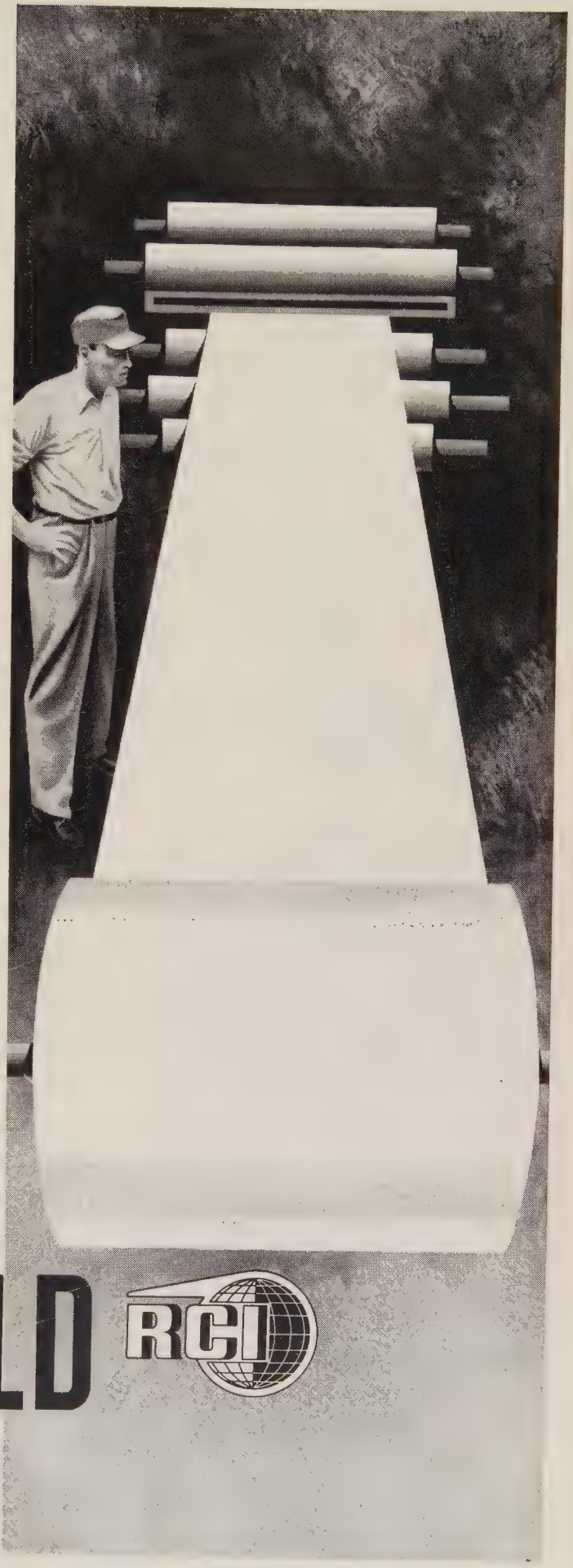

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results of 53 cooks. The highest brightness was reached with peeled poplar using a 3 hr. sodium sulphite cook without bicarbonate, at 150°C. and a pH of 6.7 to 7.1 The yield was 77 to 79%. Initial evacuation frequently helped to increase brightness whereas wetting agents had no effect.

A comparison of birch and pine for bleached sulphate (*91*) showed that birch becomes impregnated with liquor more rapidly, leading to a shorter cook. The birch pulp screens more readily than pine. The digesters are, however, more difficult to blow clean. The bulkier birch pulp dewaters more slowly on machine, is more difficult to wash, but is easier to bleach than pine. Birch is harder to bleach, however, than spruce.

Brabender (*92*) stated that Marathon cooks poplar mixed with not less than 20 to 25% softwood in order to avoid difficulty in washing the brown stock. This also helps in the washing of the bleached stock. The strength of their bleached poplar kraft approached that of bleached hemlock sulphite.

Chesley, Gilmont, and Parnell (*93*) have conducted experiments which show that knotter and screen rejects can be pulped alone or mixed with chips without excessive degradation of fiber.

The pulping of turkey oak and slash pine by the kraft process has been studied by Nolan and co-workers (*94–98*). Their findings will be included in the next section.

Japanese work on the evaluation of the papermaking properties of Japanese red pine includes that of Akamatsu (*99, 99A*) who studied soda cooking; Hata (*100*) who studied kraft cooking, and stated that it was superior to the soda process; Nakaya and Nakano (*101*) who investigated the effect of sulphidity in kraft cooking; Naumura and Okada (*102*) who worked on the neutral sulphite pulping of red pine screenings; and Hoshino (*103*) who compared the behavior of Japanese red pine, larch, and beech heartwood toward sodium chlorite as a pulping agent.

A comparison of jackpine and Scotch pine has been made by Surewicz (*104*) by means of laboratory kraft cooks. Yields were slightly higher from jackpine, and strength generally was higher for the same freeness. The greater amount of resin in jackpine required about 1% more active alkali to produce an equivalent pulp.

PULPING VARIABLES

The previous section included references to work in which the fibrous raw material might be considered as the subject of chief interest; on many of these materials, however, the variables of time, temperature, cooking liquor, etc., were studied very fully, and the data might well be compared with those of the present section.

A review of lesser-known pulping methods, which includes a section on alkaline systems, has been made by Brounstein (*105*). The status of the two major semichemical processes now in use—the kraft and neutral sulphite semichemical—was given by Sapp (*106*). These processes and the cold caustic process were compared by Converse (*107*) who also discussed trends in semichemical pulping (*108*). A review of present practice in the United States has been made by Humble (*109*) while other general discussions have been given by Stevens (*110*) and Pancirolli (*111*). University of Maine lectures which deal with various aspects of alkaline pulping, are referred to in a previous section (*39–42*).

Pineo (*112*) discussed the variables of kraft pulping including the moisture content of the wood, ratio of chemical-to-wood, ratio of liquor volume-to-wood, wood species, etc. He emphasized that a change in wood species will vary the pulp quality more than any other factor.

Methods of increasing sulphate pulp production in all departments of a mill, including wood room, digester room, screen room, and recovery system have been reviewed by Solomko and Dzhelyuk (*113*).

The importance of liquid volume and concentration in kraft cooking was examined on a mill scale by Worrell (*114*). With 950 cu. ft. of liquor in the 2750-cu. ft. digester, there was poor circulation and a nonuniform cook. Much better results were obtained with 1025 cu. ft. of liquor.

The advantages of automatic steam admission and relief controls on kraft digesters are described by McAlear (*115*).

A series of laboratory-scale experiments was carried out by Valeur (*116*) to determine the effect of the moisture content of the wood on the yield and quality of sulphate pulp from Swedish pine. The moisture content during the chipping operation apparently had no effect. Moist wood and wood which had been dried and then moistened gave similar results. When dry wood was pulped, it gave a product with a slightly lower strength and somewhat higher screenings content than did the moist material. Steaming the dry wood, however, led to a quality similar to that from moist wood.

The effect of chip size on the rate of alkaline pulping of slash pine was studied by Nolan and Brown (*94*). The chips were reduced in size by passing them through a hammermill either dry or after having been steamed for 10 min. in dilute sodium carbonate solution at 170 p.s.i. and were then separated into fractions of 4, 6, 8, 10, and 16-mesh cross sections. The length of the pieces remained the same as the original chip. The strength of the pulps from 4 through 8-mesh wood was constant, 10-mesh showed a slight decrease, and 16-mesh a marked decrease. Using the unfractionated material, the cooking time of $2^1/_2$ hr. for regular chips could be reduced to $1^1/_2$ hr.; the screened yields were 50% instead of 43.4%, and the strength of the pulps compared favorably with that from regular chips—especially when the presteaming treatment had been used. Almost 25% more wood could be packed into a digester.

Nolan, *et al.* (*95*) studied the conditions necessary for the rapid, continuous pulping of turkey oak and slash pine, and concluded that when constant temperature and sustained liquor concentration are used to promote a rapid reaction, the chips required mechanical treatment to expand their surface before cooking. Otherwise, high screenings were obtained. With chips which had been presoftened and then hammermilled, pulps of high alpha-cellulose content could be obtained in 15 min. at 148 p.s.i. With oak, a liquor of 25% sulphidity and $3^1/_2$% concentration gave a 43.7% yield. With pine, 50 grams per liter was a more suitable concentration. Tear and double fold were superior to pulps made by a standard batch process, but the burst and breaking length were somewhat lower.

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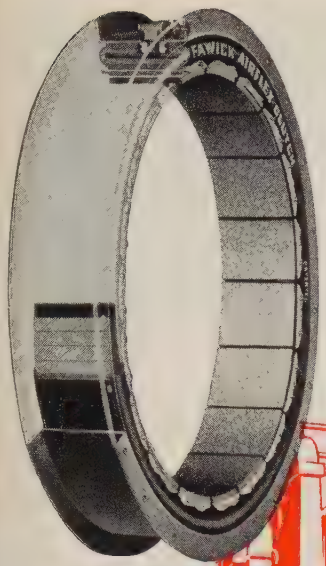

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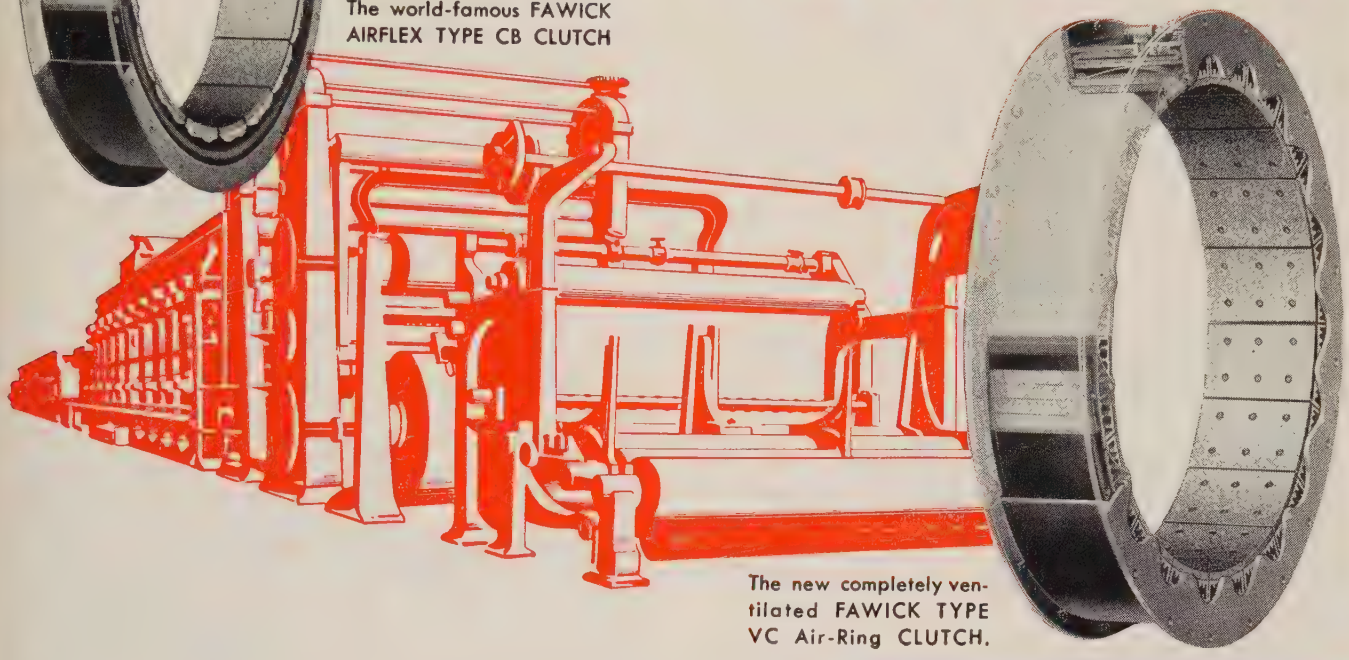

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Further studies by Nolan and co-workers (*96*) indicated that the yield, lignin, pentosans, and alpha-cellulose percentages in the pulp could be closely controlled by specification of the pulping variables. Results suggested that turkey oak could be readily converted into a high-grade dissolving pulp by rapid and continuous cooking.

Rothrock and Nolan (*97*) studied the effect of variations in sulphidity and the recycling of black liquors on the kraft pulping of scrub oak. They found that 30 to 40% sulphidity was most suitable for an easy-bleaching pulp. Other conditions necessary were 16% total chemical at a concentration of 35 grams per liter (expressed as Na_2O) and pressure of 115 p.s.i.g. for $1^1/_2$ to 2 hr. after a 1-hr. rise to pressure. Adding black liquor caused an increase in the amount of screenings.

A review of much of the above work has been given by Nolan and Brown (*98*) and a solid-liquid interface theory presented in contrast to the old penetration theory.

Jayme and Licht (*117*) studied the effect of sulphidity on the alkaline pulping of beechwood. Using 14 different sulphidities (0 to 30%), they concluded that the average optimum was 20%. This is considerably lower than the 30 to 40% found by Rothrock and Nolan (*97*) for scrub oak.

Jayme and Wörner have made an extensive study of the pulping of spruce with alkaline reducing agents. Pulps of high brightness, and satisfactory in other respects, could be obtained with sodium hydroxide and sodium hydrosulphite if the correct proportions were used (*118*). Comparison of a soda, sulphate, and hydrosulphite cook at 180°C. to 44 to 45% yield showed that 4 hr. were required for soda and sulphate and 8 hr. for the hydrosulphite cook. The residual lignin was 5.7, 3, and 2.17%, respectively, while the strength properties increased in the same order. By bleaching, brightness values of 82, 76, and 86% were obtained—the value for the hydrosulphite pulp approaching that of a sulphate pulp obtained after an eight-stage bleaching with chlorine dioxide. These same authors (*119*) also have compared cooks made with sodium hydroxide to which sodium hydrosulphite (I) or sodium sulphite (II) or both (III) had been added. The holocellulose content, yield, and brightness increased in the order (II), (III), (I). Jame and Wörner (*120*) also studied the effect of varying the percentage of sodium hydrosulphite added to soda or kraft cooks. The effect was to give an increased yield, a higher D.P., better burst, breaking length and fold, and a very light-colored spent liquor with increased sodium hydrosulphite. The residual lignin could be removed more easily, thus, leading to a higher brightness. The entry of sulphur into the lignin molecule is apparently prevented or diminished, and furthermore, the lignin is not oxidized. The authors have extended their work to beechwood (*121*) with favorable results, the process compensating to a large extent for the morphological disadvantages of thick cell walls and short fibers found with this material. The results are believed to warrant large-scale mill trials.

The physical properties of a slash pine semichemical kraft pulp (I), its chlorited component (II), and a chemical kraft pulp (III) were compared by Keeney (*122*) and the strength was found to decrease in the order II, III, I.

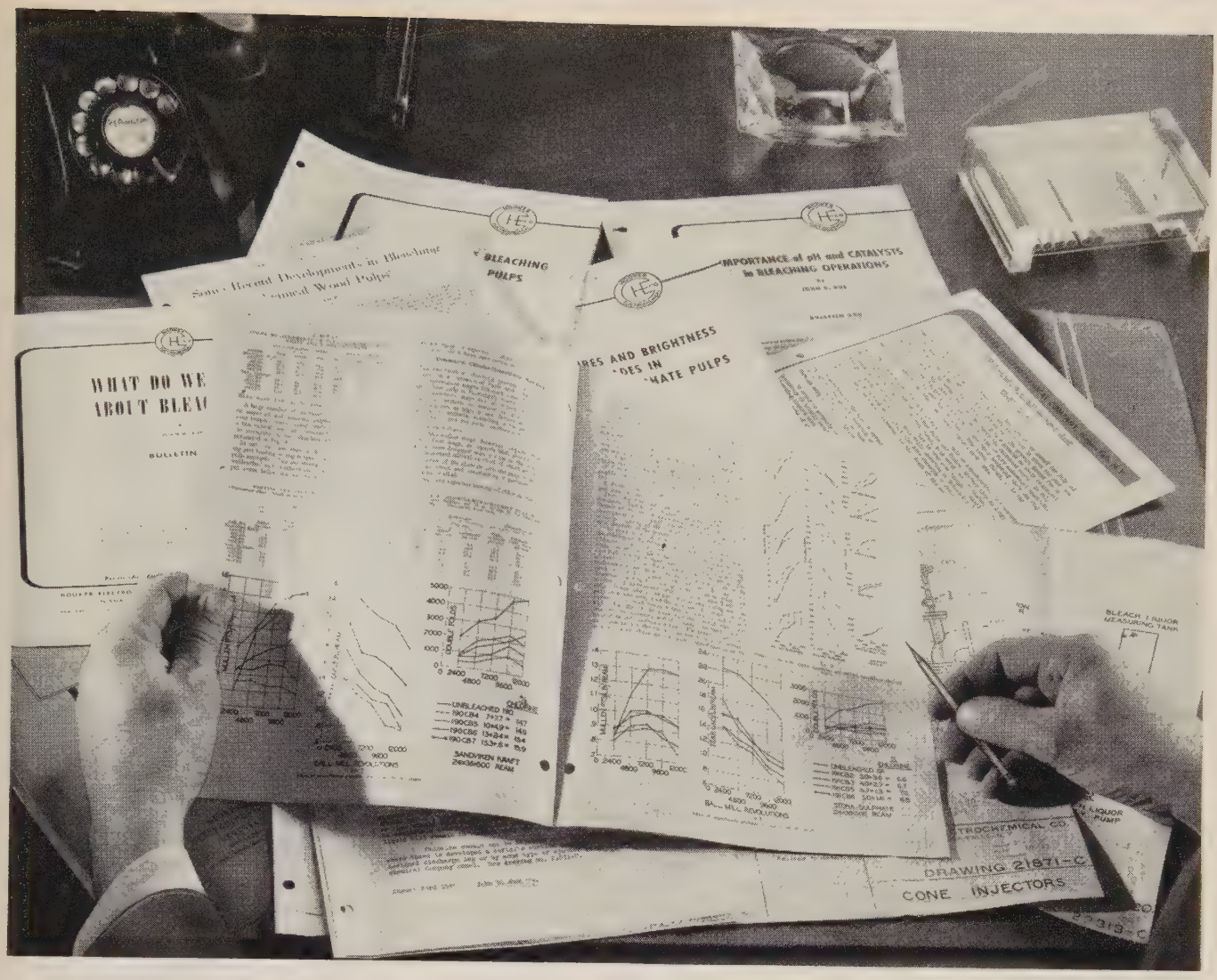
Two mills have given their experiences with the conversion of part of their operations from a kraft to a soda cook. Keswick (*123*) (cf., 22,691) for the Bathurst Power and Paper Co. stated that the absence of sulphur compounds eliminated odors and the need for washing, and the pulp gave excellent results as a corrugating medium when mixed with 20% kraft stock. The flat-crush is approximately double that obtained on the previously made kraft medium. West (*124*) discussed the results obtained at the Thilmany Pulp & Paper Co. in 1947–48 when they found that the use of straight caustic in place of kraft for their poplar cooks, gave a pulp that was much easier to wash and handle and was better for soft, bulky sheets.

The influence on sulphate pulp properties of cooking pine chips at high alkali concentrations was studied by Nenenin and Sanitsyna (*125*). Single and two-stage cooks were conducted, the object being to produce high alpha-cellulose pulps. As one example of the many conditions used, at 150°C., and 26% sulphidity, the percentages of active alkali studied were 30, 40, 50, and 100. As the concentration of alkali increased, the rate of pentosan solution was greater than the rate of cellulose solution to the point where only difficultly soluble cell wall pentosans remained, when the rates were reversed. With a two-stage cook, the best results (86.5% alpha-cellulose) were obtained at 150° without intermediate washing and with 40% active alkali. High sulphidity in the first stage did not result in a satisfactory pulp.

The patent literature reveals a number of alkaline processes for cooking wood, several of them involving more than one stage. Miller impregnated chips with a sodium carbonate (*126*) or sodium hydroxide (*127*) solution by heating to just above the boiling point and venting intermittently. This is followed by soaking, draining, and cooking with lime at 212 to 450°F. Sivola (*128*) suggested a three-stage process involving an acid bisulphite digestion which is converted to an alkaline one by injecting alkali. Briggs (*129*) recommended steam chips at 140 to 200°C. with no free liquid present before carrying on with a normal alkaline cook, while Michon's process (*130*) consists of treating the chips with liquor and completing the cook after the excess has drained off. Tarkkonen (*131*) suggested charging the digester with hot black liquor and chips together and added the required amount of white liquor after packing. Sutherland's claim (*132*) involves a short alkaline cook to soften the encrusting material followed by hot refining. Magnuson (*133*) modified the Asplund process by soaking the chips for 4 to 28 hr. at room temperature before defibering at 150 to 170°C. Fisher and Mead's process (*134*) involved the use of 2 to 15% sodium aluminate solution at 185 to 200°C. for $2^1/_2$ to 3 hr.

A development of the cold caustic process is said to show promise (*135*). The chips are soaked in 2.5% caustic at room temperature for 2 to 3 hr., the excess caustic is stripped from them with steam, and they then go to the refiner. Yields up to 90% of a product suitable for corrugating board are claimed.

Yundt (*136*) described a 50-ton pilot plant operation using a cooking system designed to give good penetration and a uniform cook. The gum or oak chips are steamed to expel the air and are then soaked in liquor



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for 4 hr. The chips are drained and then cooked in a conventional continuous cooker.

Experiments were carried out by Adams and Tennant (*137*) with a laboratory Asplund, designed to produce pulps suitable for flooring and roofing felts from hardwoods by the soda or kraft process. The strength increased with decreasing lignin and with increasing sheet density. For any given density there was an optimum amount of chemical for maximum strength. In the range of the low sheet densities, the soda process gave greater bursting and tensile strengths than did the kraft process.

A mill study of kraft pulp refining has been made by Syme and Dawson (*138*) in which jordans, hydrafiners, and beaters were compared for their power consumption and effect on pulp quality. Sutherland (*139*) discussed the Sutherland refining system. The Sprout-Waldron refiner in high-yield kraft processes is summarized by *Paper Mill News* (*140*).

Finnish experienced in the semichemical pulping of the unbarked sawmill waste, gained through 2500 experimental cooks, was outlined by Sihtola (*141*). The time was varied from 5 to 60 min., the temperature from 130 to 200°C., and the bark percentage from 0 to 24%. Extensive fiber degradation occurred at high temperatures and low chemical ratios. A light, strong pulp from coniferous woods was obtained in less than an hour's cooking time provided the chips were effectively presoaked and the cook took place on the acid side. Straight caustic pulps required high energy input for refining but when the lignin content exceeded 28% the power consumption dropped.

Neale, Pearson, and Somerville (*142*) reported that eucalypt groundwood can be considerably strengthened by extracting the stock with alkali. Three per cent caustic at 50°C., for 3 hr. removed 12% of the wood, doubled the tear factor, and tripled the burst. Sodium and potassium hydroxides were more effective than calcium or ammonium.

Meller (*81*) described the preparation of dissolving pulps from eucalyptus by a mild kraft cook.

Equations were developed by Cohen and Mackney (*143*) relating the analysis of certain eucalypts to the properties of the pulps obtained from them, by either the soda or kraft process. These equations enable the prediction of the lignin content or permanganate number from a knowledge of the percentage of hot water solubles or the caustic consumption. A correlation was found between the lignin content and the permanganate number of soda pulps at the 0.1% level.

Borlew (*144*) presented evidence that the Roe chlorine number (as modified by the Bathurst Power & Paper Co., Canada) is a more useful guide in routine control of high-yield and ordinary kraft cooking than the conventional permanganate numbers.

A method of determining lignin in pulps was given by Bethge, *et al.* (*145*). The pulp is dissolved in 80% phosphoric acid and absorbency at 280 mmu is measured spectrophotometrically the next day. For sulphate pulps, thiolignin is used for comparison.

The influence of cooking and bleaching conditions on the opacity of kraft pulps was studied by Giertz (*146*). The opacity increased with cooking time and with increasing amounts of alkali and was closely related to the yield of bleached pulp. For the same yield, sulphate pulps had a higher opacity than did sulphite pulps; this was considered by him to be due possibly to the formation of structural bonds in the fiber during the sulphate cook, most probably in the hemicellulose fraction.

A summary and a critical review of the present knowledge of the reactions and chemical balances in the kraft process were made by Holzer and Booth (*147*). The gap between the test tube and 5-ton digester, and the need for pilot plant studies were emphasized, the indication being that much of the available basic information is too far removed from commercial practice.

The chemistry of the sulphate process has been studied and a mechanism proposed by Enkvist and Moilanen (*148*). The work involved an investigation of the reaction between sodium hydrosulphide and 22 lignin model substances. The lignin molecule is considered to consist of building stones held together by phenol ether bonds and cross-linked by dialkyl ether bonds to form a high molecular network. During the cook the sodium hydroxide splits the phenol ether bonds producing phenolic OH groups which activate the dialkyl ether cross-linkages which then become susceptible to cleavage by the sodium hydrosulphide.

The time required for washing kraft pulp was shown by Gothner and Robson (*149*) to be capable of reduction by using Markila-Brax strainers (*150*) or crossed angle iron supports in conventional diffusers.

The prerefining of kraft pulp was discussed by Saunders (*151*). The two advantages of higher yield and lower chemical costs are balanced to some extent by the cost of the original purchase, operation, and maintenance of additional equipment, and the possible plugging of rotary screens by small fibers. The experience of the Marathon Corp. in the washing of poplar kraft was discussed by Brabender (*92*). By mixing 20 to 25% of softwood with their hardwood, washing improved both before and after bleaching.

The bleaching of sulphate pulp has been studied by van Nederveen, *et al.*, (*152*). The effect of pH on the oxidation potential of sodium hypochlorite, chlorite, and hydrogen peroxide is discussed in the light of its effect on the resulting pulp properties. Instrumentation in kraft bleaching was discussed by Scrivens (*153*).

A comparison between the behavior on the machine of neutral sulphite and kraft semichemical pulps has been made by Marteny (*154*). The former requires a higher consistency in the headbox and less flat suction boxes than does the latter. However, it dries with greater difficulty, is more susceptible to tension in drying, has less strength in the wet web, and requires less calendering than does kraft.

Stephen (*155*) has made a statistical analysis of the limits of variability in a kraft mill. He dealt with the hardness of stock, per cent activity of white liquor, and fiber loss at the shaker screen.

CORROSION

The University of Maine lecture on corrosion by Horigan (*45*) is divided into three parts: forms of corrosion, corrosion-resistant metals, and applications. The second report of the activities of the TAPPI Digester Corrosion Subcommittee was described by Teeple (*156*). A procedure recommended by this committee for acquiring and recording data pertaining to the cor-

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rosion of alkaline digesters and to the service life of the vessel has also been presented (*157*). The meeting of the committee held in Chicago on Oct. 13–16, 1952, was reviewed by Lientz (*158*). It appeared that the use of field linings in digesters was not always dependable. Some mills experience corrosion in digesters made of stainless steel clad plates, but Inconel-clad and carbon brick linings seem promising. The present trend in new digesters seemed to be toward the use of very thick carbon steel units, with types A-285 grade B and C predominating. A paper presented at this meeting by Shoumatoff (*159*) was subsequently published. By statistical methods data from three semiannual sets of thickness measurements of a typical sulphate digester were presented and analyzed in detail. It was concluded that the inspection procedure based on such measurements is a powerful and reliable tool for the study of digester corrosion.

The analysis of corrosion questionnaires sent to 63 pulp mills has been reviewed by Peoples and Ericson (*160*). It revealed that corrosion has been greater in digesters installed during the last 10 years. The reason for this could not be established.

Stockman (*161*) has outlined Swedish work on this problem. They have studied the influence of the various components of the white liquor on steels with various percentages of silicon, carbon, or magnesium, and although all the results are not yet available, there are indications that thiosulphate and sulphur have a pronounced influence on corrosion.

Corrosion in storage tanks and cars due to sulphate turpentine was stated by Dusenbury and Reese (*162*) to be combated by adding 0.25% of aqueous ammonia.

STREAM POLLUTION

A critical review of the literature of 1951 relating to stream pollution was given by Rudolfs and Nemerow *et al.* (*163*) and contained a section on pulp and paper mill wastes. Gehm (*164*) has also reviewed the problem, as has Murdock (*165*). Murdock (*166*) later stated the position of potamologists toward it. They believe that the best biological index for the evaluation of stream conditions is the one based on the sessile forms of plants and animals in a stream at different locations, because they reflect water conditions which have existed over a considerable period of time. This is considered to be far more significant than a mere chemical analysis which represents only the stream conditions at the time of sampling the water.

The location of a kraft mill in regard to stream pollution was discussed by Sylvester (*167*) with reference to the special problems of the Willapa River estuary in southwestern Washington, where two local cities and wood waste from sawmills, contribute to the problem.

A review by Moggio (*168*) dealt with proposed methods of handling mill wastes; he stated that the disadvantages of processes to date have been the cost of treatment and disposal of large quantities of sludge. A promising chemical treatment now under study involves the use of excess lime and carbonation, followed by recovery of the lime in the precipitated sludge.

French work at Grenoble on the effluent from straw mills was described by Chêne, Deissenberg, and Lion (*169*). From lime cooks, excess carbon dioxide is passed through and then the liquor is neutralized with lime to pH 7.5. The B.O.D. is reduced. From soda cooks, however, adding sulphuric acid to pH 7.8 increases the B.O.D., although the liquor contains less organic matter. With neutral sulphite liquors from a hard and softwood cook, it was found in the latter case that precipitating ferrous or aluminum hydroxide in the liquor reduced the B.O.D. considerably.

Eden, Jones, and Wheatland (*170*) described the pilot plant treatment of the entire effluent of a British mill using hemp, linen, cotton, etc. using a percolating filter. The wastes were the spent soda liquor from the digester plus the first washings (I), strong washings (II), and final washings, white water, etc. (III). All the liquor could be treated in this way if the pH were controlled, if the residual chlorine were removed, and nitrogen and phosphorus were added. To treat a daily production of 1,650,000 gal. of (III), 55,000 gal. of (II), and 13,000 gal. of (I), it was estimated that filters containing 11,800 cu. yd. of medium would be required. However, the cost of chemicals would be considerable, particularly if ferric chloride were required to reform a flocculent precipitate after pumping of the liquid to settling tanks.

A general discussion of the treatment of pulp and paper mill effluents in Great Britain was included in an article by Horlock, Isabell, and Jobin (*171*).

Rudolfs and Nemerow have made an extended study of the waste from specialty mills using rag, rope, and jute. In a consideration of physical and chemical wastes (*172*), it was calculated that the total volume of cooking liquors and wash waters averages 73,000 gal. and contains approximately 750 lb. of B.O.D. and 2000 lb. of total solids per ton of paper produced. Approximate analysis of the organic constituents showed lignin, volatile acids, polysaccharides, greases, and proteins. There was a general relationship between total alkalinity, B.O.D., and total solids. With the exception of rag beater wash water, the wastes did not contain sufficient organic nitrogen to support adequate biological life in a treatment process. In a study of load distribution and its effect on the total mill effluent (*173*), Rudolfs and Nemerow found that the cooking liquor and the first hour of wash water included 90% of the B.O.D. in only 36% of the total waste. The chemical treatment of rope cook liquor (*174*) indicated that most good coagulants gave excessive quantities of sludge and not much reduction of B.O.D. A three-stage treatment with ferric chloride, sulphuric acid, and alum in separate, successive stages, gave a 50% reduction in B.O.D., a total sludge volume of 27% of the original waste with 82% reduction in turbidity, and a practically colorless effluent. Biological treatments included anaerobic (*175*) and aerobic (*176*) digestion. In the former method, the spent liquors (when neutralized and fortified with nitrogen and phosphorus) are digestible at minimum loadings from 0.027 to 0.056 lb. B.O.D. per cu. ft. of digester capacity per day, effecting from 72 to 82% B.O.D. reductions. Sodium sulphite retarded or inhibited the digestion of rope waste and so a method was devised for removing it. Jute waste required a retention period of only 2 days, rag waste 4 days, and rope waste 6 days. Treatment by aeration involved the factors of pH, nutrients, seed adaptation, air supply, and temperature. At optimum conditions

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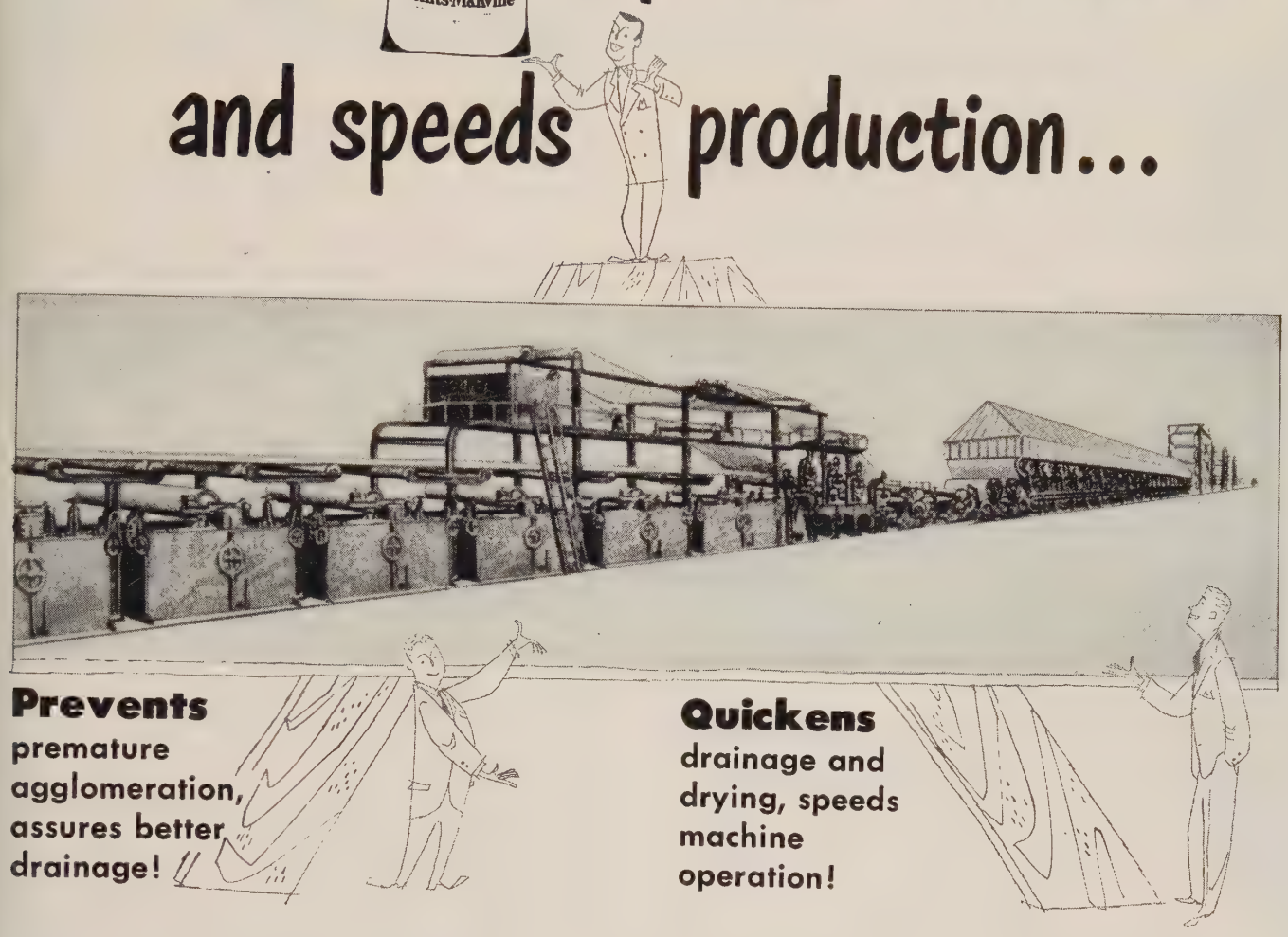

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the B.O.D. of about 2000 p.p.m. was reduced by 78 to 96% in the presence of dispersed growth and by 90 to 98% with sludge floc after 24 hr. of aeration. Rope and rag liquors gave excessive and stable foam.

Rudolfs and Hanlon (*177*) also studied the removal of color from rope, rag, and sulphite cooking liquor wastes. The intensity of color decreased with decreasing pH and with increasing hardness of the water. Aerobic and anerobic biological treatment increased the color of rag liquors and board mill white water but decreased the color intensity of jute cook liquor.

Rudolfs and Amberg have considered the pollution of streams by white water in a series of papers dealing with factors affecting anaerobic digestion (*178*), the effect of sulphites (*179*), factors affecting digestion efficiency (*180*), and inesophilic and thermophilic digestion (*181*). They are not amplified because they are rather beyond the scope of this review.

The effect of kraft mill waste on certain salmonoid fishes of the Pacific Northwest has been studied by Haydu, Amberg, and Dimick (*182*). The minimum lethal and critical concentration for the most susceptible fish species was 0.5 to 1.0 p.p.m. of sulphides and methyl mercaptan, but a large percentage of the trout and salmon completely recovered if removed to fresh water immediately after reaching the "belly-up" stage. It was concluded that the amounts of sodium hydroxide, carbonate, thiosulphate, and sulphate which would normally pass into the sewer would be insufficient to kill salmonoid fishes of the Pacific Northwest. Of the four compounds, sodium hydroxide is the most critical with a limit of about 10 p.p.m.

A rapid polarographic method for measuring dissolved oxygen in B.O.D. determinations was described by Busch and Sawyer (*183*). It was tried on rag and rope wastes, among others, and the accuracy compared favorably with the standard Winkler technique. It required 75 sec. for a determination.

BLACK LIQUOR

Two University of Maine lectures on sulphate recovery units have appeared. They are by Coulter (*43*) and Owens (*44*). A discussion of the subject is given by Malyutin (*184*). Edling (*185*) discussed the possibilities for Swedish mills to become self-supporting in fuel requirements by using the heat from burning liquor; he believes that this might be possible if strict control were exercised at all phases of the operation. The recovery system of the West Virginia Pulp & Paper Co. kraft mill at Charleston has been outlined (*186*), and it appears that, in addition to chemicals, 47% of the total steam requirements of the mill is obtained. Tomlinson (*187*) has described the system in operation at the Howard Smith mills and discussed the advantages and economics of their equipment. It involved black liquor oxidation, spray towers, cyclonic evaporators, deluge and condensing towers, and a new type of fan for supplying combustion air. Apparatus for concentrating black liquor and recoverying heat and chemicals without the release of noxious sulphur compounds, has been patented by Tomlinson and Swartz (*188*) and Tomlinson and Tomlinson (*189*). A flash drying process for evaporating the liquor has been patented by Paren (*190*), while Hamm's invention (*191*) provides means for obtaining relatively high steam temperatures in superheaters associated with the recovery furnace. Wilcoxson (*192*) patented a special nose baffle to deflect the flow of heating gases to a circular path.

The chemical reaction equilibria in the combustion of sodium-base pulping liquors have been studied by May (*193*) using thermodynamic principles. By this method it was possible to show why the usual products are obtained in the kraft recovery process and to give a possible explanation for the explosion difficulties sometimes encountered in the dissolving of a kraft furnace smelt.

It has been pointed out by Brabender (*92*) that the higher yields of pulp obtained from hardwoods mean less solids in the liquor and greater difficulty in burning it.

The intensity of the odor released at various points in the kraft pulping process has been studied by Schoening and Wright (*194*) at the Port Alberni sulphate mill. The gases measured (hydrogen sulphide and methyl mercaptan) had their highest concentration in the blow tank and stack gases. The highest concentration of methyl mercaptan found in the blow gases sometimes reached 100,000 mg. per liter. When the digester charge contained about 200 lb. of elemental sulphur, the release of odorous substances in noncondensable blow gases increased threefold. The loss of sulphur from the blow tank may be greater than 20 lb. per cook. There seemed to be slightly more odor from Douglas-fir than from hemlock.

Felicetta, Peniston, and McCarthy (*195*) found with the mass spectrometer, that hydrogen sulphide, methyl mercaptan, dimethyl sulphide, and dimethyl disulphide were present in kraft mill process streams. The corresponding ethyl compounds were not present to any great extent. The authors developed a relatively simple method for determining each of the four compounds. This involved absorbing the two acidic substances in aqueous sodium hydroxide while the two thioethers were simultaneously absorbed in a layer of benzene. The liquid phases were separated, the two alkali-soluble compounds detemined potentiometrically with silver nitrate, and the two thioethers by bromate-bromide titrations after partial separation in a single-stage distillation.

Bialkowsky and DeHaas (*196*) reviewed the sources of odor and sulphur losses in a mill and described a rapid method for determining sulphur in gas streams. This method involved catalytic oxidation of the sulphur compounds to sulphur dioxide in a quartz tube at 1000°C. The sulphur dioxide is converted to sulphuric acid by means of hydrogen peroxide and the acid determined by changes in pH. The time required is less than a minute; the method permits continuous recording; and the sensitivity is such that it will detect a fraction of a part per million. Sulphur dioxide in the original gas can be measured by by-passing the combustion tube.

The installations in Sweden for oxidizing black liquor have been described by Trobeck (*197*, *197A*). The advantages of oxidation are that there is less corrosion of evaporators, reduced odor trouble, higher sulphidity of cooking liquor with resulting saving of lime, reduced gas in evaporators, and, therefore, more uniform operation, and the production of fuel in a dry form. A

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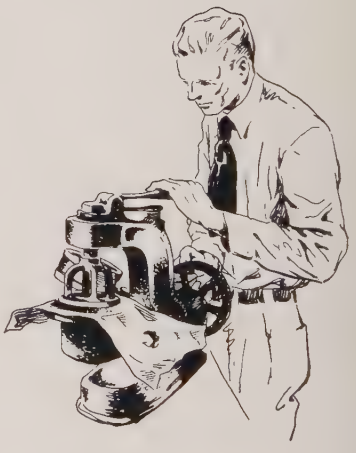

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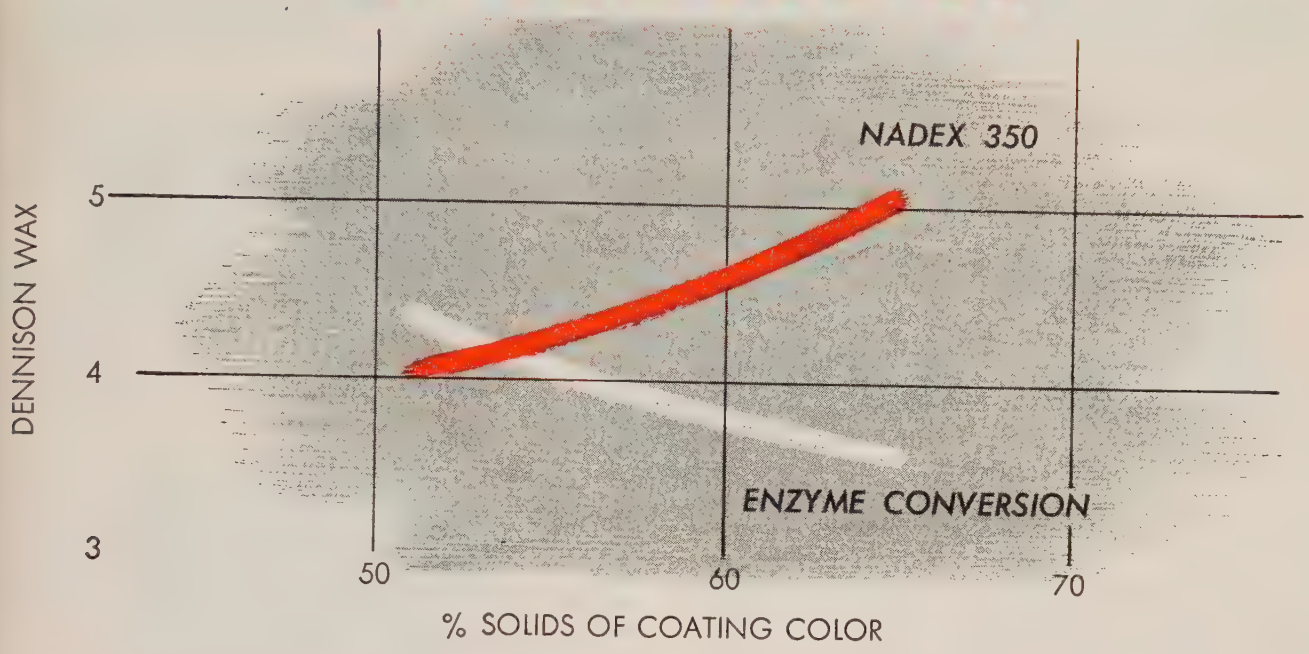

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possible disadvantage is the higher viscosity of the liquor. In the oxidation, sodium sulphide is presumed to be oxidized to thiosulphate. The liquor from one ton of pulp contains 2800 lb. of solids which increase to 2860 lb. after oxidation, consuming 49.5 lb. of air and liberating 1136 B.t.u. of heat in 1.5 hr. A Canadian patent relating to this process is that of Bergström and Trobeck (*198*).

The oxidation tower at Springfield, Ore. has been described (*199*) and is claimed to greatly reduce the odor problem. It was designed for 300 gal. of liquor per min. and the recovery of sulphur is such that no additional sulphur is required.

Wright (*200*) described the work of the British Columbia Research Council (*200A*) on black liquor oxidation and stated that the new packing developed by them for the Bergström tower eliminated foaming. Mill trials showed that odorous substances are removed very effectively.

A routine method for the control of black liquor oxidation has been described by Mannbro (*201*). The formula for the efficiency of an installation is:

$$b_1 + \frac{(a_1 - b_1) - (a_2 - b_2)}{4} = b_2$$

where a_1 and a_2 represent the iodine consumption of the nonoxidized and oxidized liquor before boiling with ammonium chloride, and b_1 and b_2 represent the iodine consumption after boiling with ammonium chloride.

The kinetics of oxygen absorption by black liquor at 1 atm. pressure between 40 and 90°C. has been studied by Wright (*202*). The results were interpreted on the basis of simultaneous reactions, including a first order reaction which is predominant at first and then is succeeded by slower reactions which continue indefinitely. The oxidation of sodium sulphide is considered to be the first step, requiring 2 or 3 min. when large surfaces of liquor are available. Between 60 and 90° temperature has little effect on the rate. One volume of liquor requires 1 to 3 volumes of oxygen or 5 to 15 volumes of air for complete oxidation of the sulphide, but in practice, larger volumes are required in order to maintain the reaction rate. Sodium sulphide and methyl mercaptan oxidize more rapidly in black liquor than in pure alkali, presumably because of catalytic action in the former.

The volumetric determination of sulphate in kraft liquors has been described by Leontbev and Frolova (*203*). In the calculation of per cent reduction, sulphate is determined by diluting the green liquor 1:10, adding 2 drops of methyl red to 5 ml., adjusting to orange with 0.1 *N* hydrochloric acid and adding 2 drops excess, adding 10 cc. 0.1 *N* barium chloride, and titrating with 0.1 *N* potassium chromate solution. In analyzing dilute black liquor, it is acidified with concentrated hydrochloric acid, evaporated to dryness, and ashed.

A rapid method for the analysis of black liquor for carbon and sulphur was described by Sutaone (*204*). One gram of dried liquor, 1 gram of potassium chlorate, and 15 grams of sodium peroxide are fused in a Parr bomb and the sodium carbonate is then determined potentiometrically with hydrochloric acid while the sulphur is measured as barium sulphate.

Young (*205*) modified TAPPI Standard 625 m-48, which determines the amount of active alkali in sulphate liquors, so that it could be used for soda liquors from straw, esparto, etc. The barium chloride is omitted and a pH of 11.3 to 12.1 instead of 8.3 is used for the end point.

A patent for a vibrating screen mechanism to feed salt cake into the mixing tank has been obtained by Hochmuth (*206*). The caustic room operation at the Tacoma mill of the St. Regis Paper Co. has been described by McCorry (*207*) and their operation on a fresh line consumption of 6 to 12 lb. per ton of pulp is considered to be very low.

Kahn (*208*) has patented a process for clarifying white liquor which involves centrifuging and treatment with a magnesium compound. Some aspects of white liquor analysis were discussed by Borlew (*209*). He recommended that the hydroxide, sulphide, and carbonate contents be calculated from a titration to the methyl orange end point and to the phenolphthalein and methyl orange end points after treatment with barium chloride.

The construction details of a rotary lime kiln were given by Hollefriend (*210*) who discussed the advantages of a small diameter feed end and an enlarged diameter burning zone. The flash drying of lime sludge was described by Vranian and Nickerson (*211*) who stated that it increased the capacity of the kiln by 40%. Friis-Hansen (*212*) described the burning of lime sludge in Sweden and discussed the heat consumption, economics, and operating data from a number of mills. He felt that kilns which are other than rotary are not suitable. The National Safety Congress (*213*) indicated the hazards involved with lime handling and how to treat burns caused by this material.

KRAFT PULP AND PAPER

The 1951 (*214*) and 1952 (*215*) reviews of the unbleached kraft paper industry were presented by Every. About 2,400,000 tons of unbleached kraft paper were sold in 1952. This was only 7% less than the record year of 1951.

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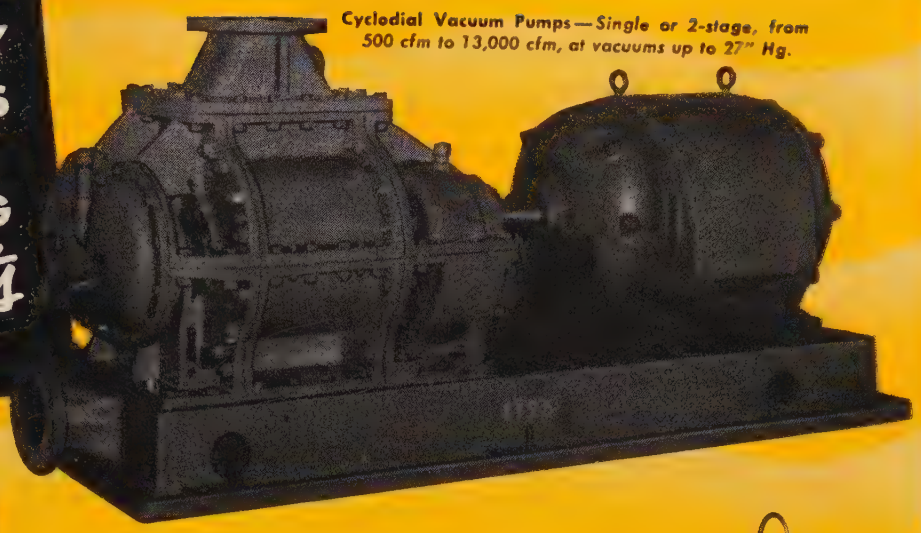

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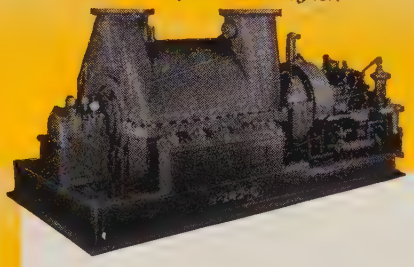

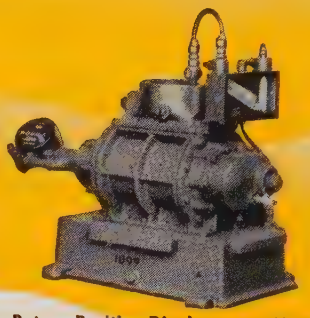

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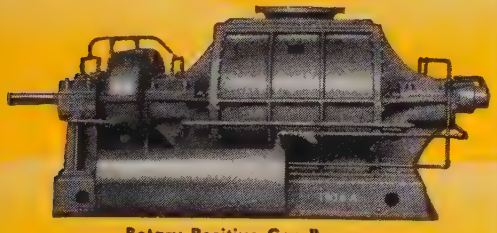

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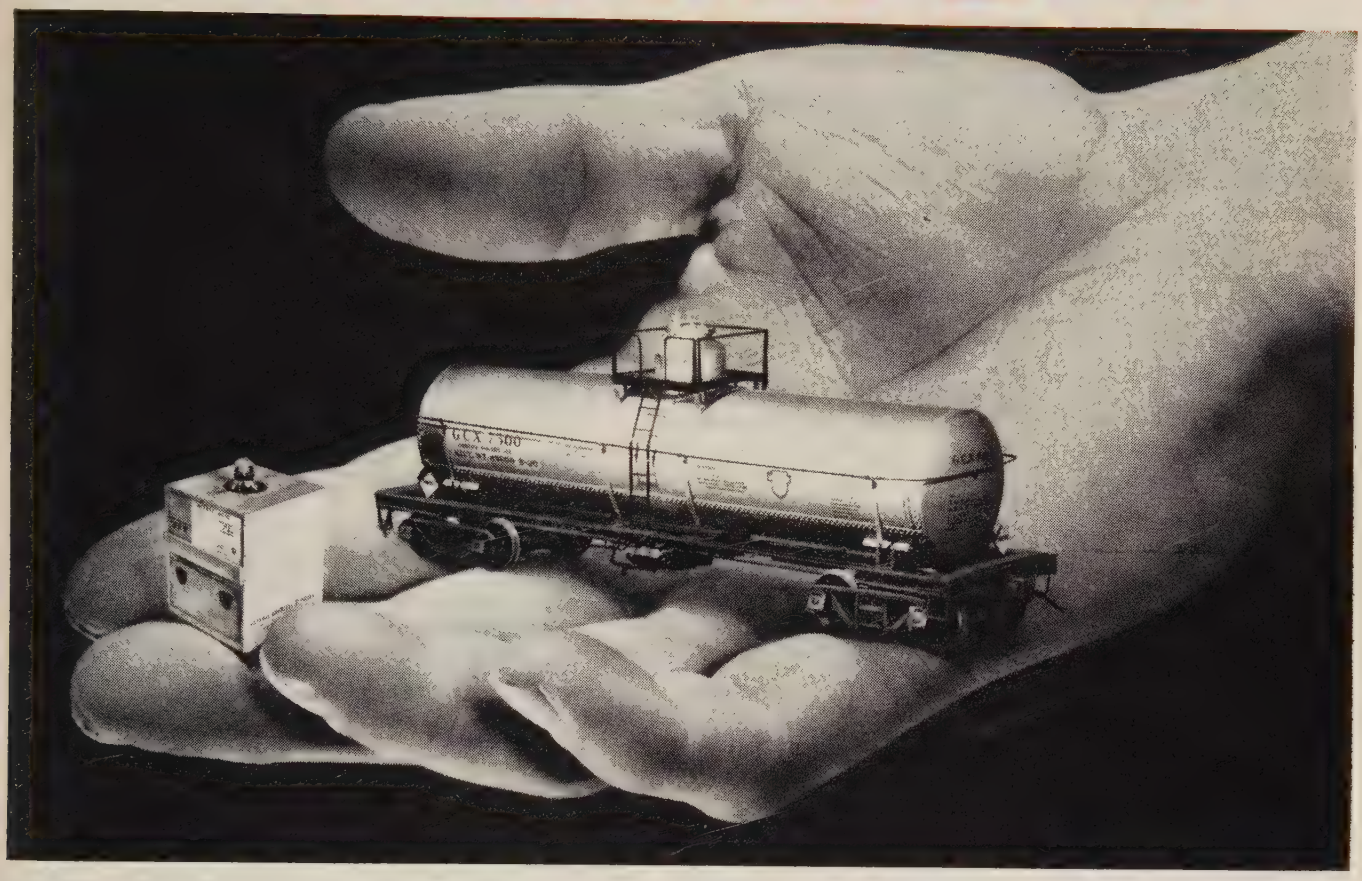

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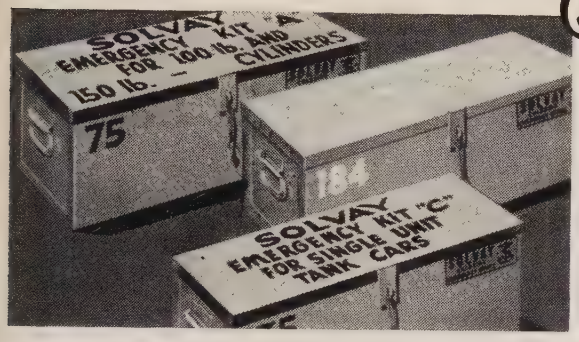

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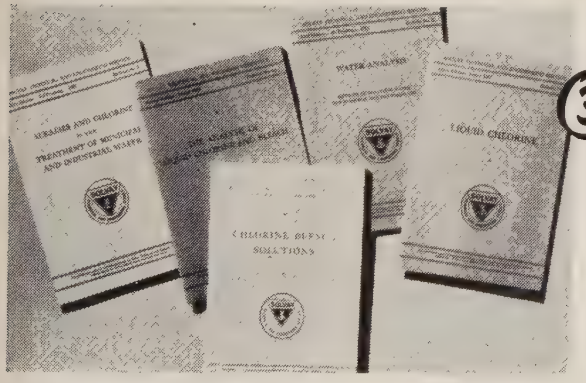

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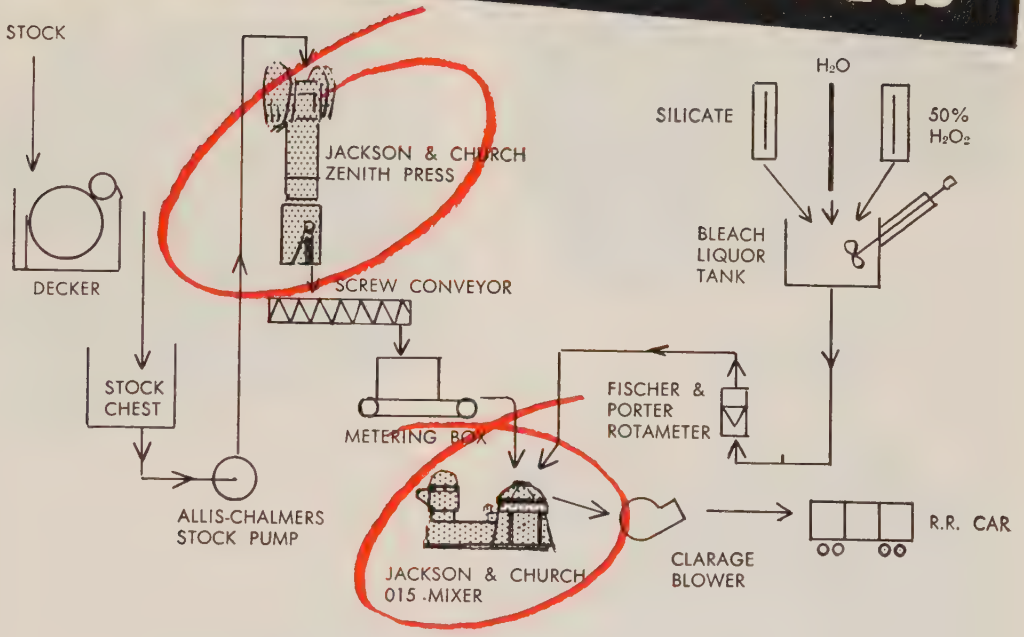

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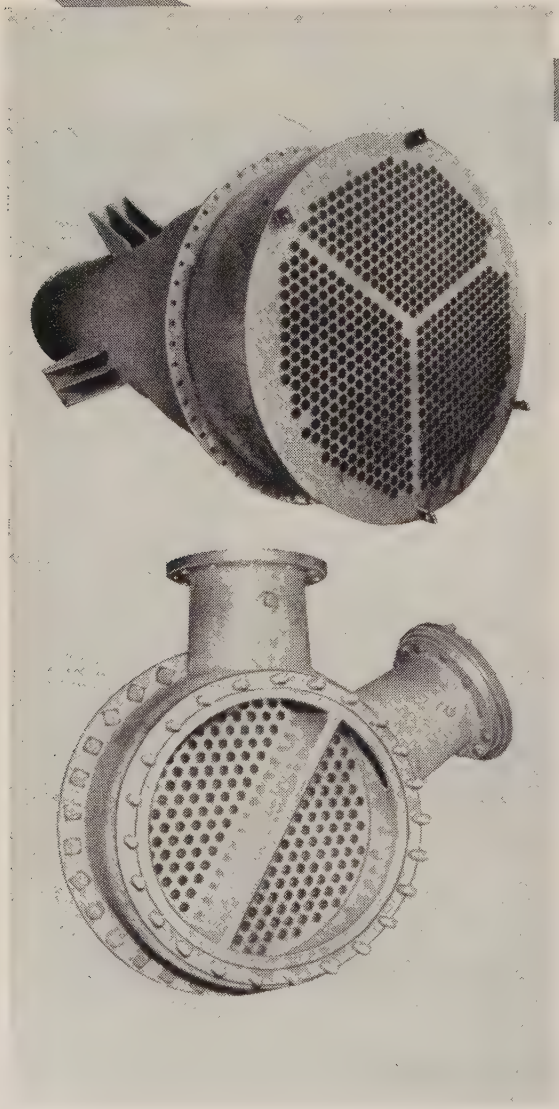

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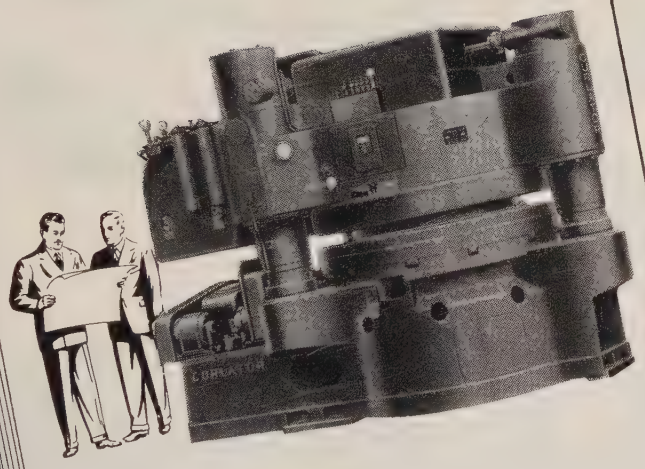

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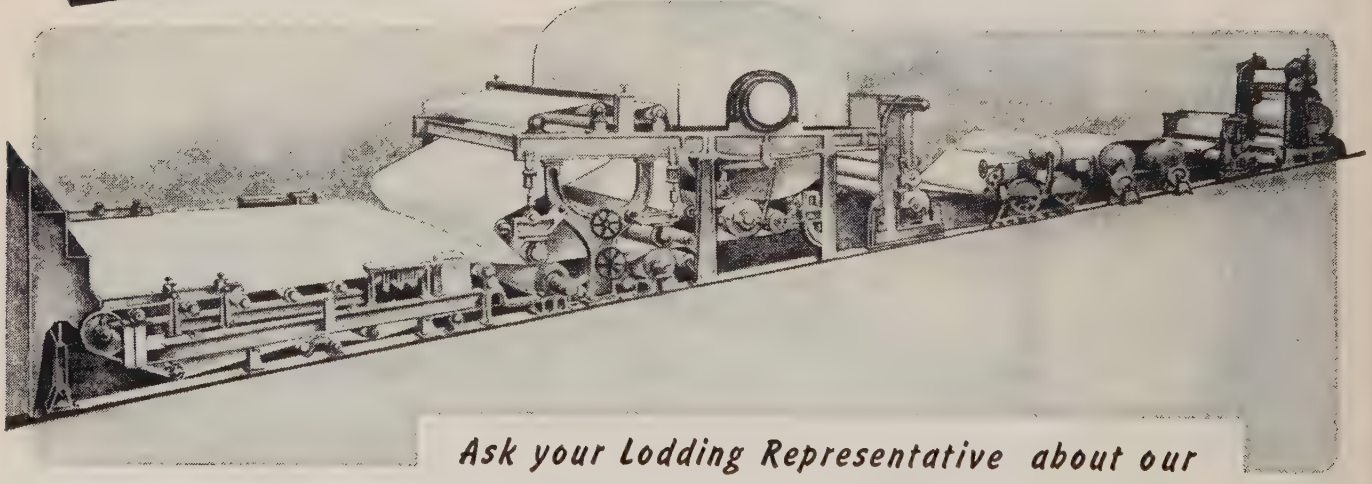

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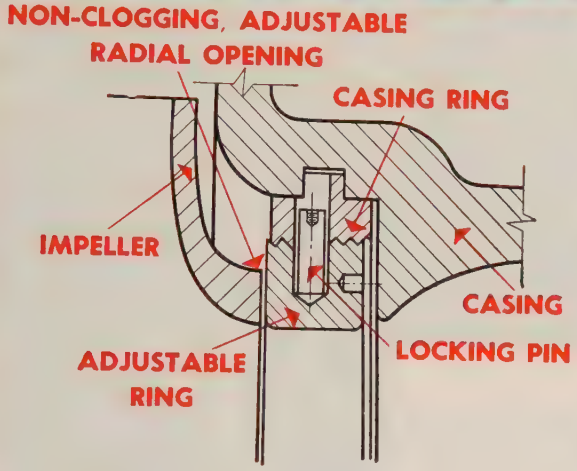

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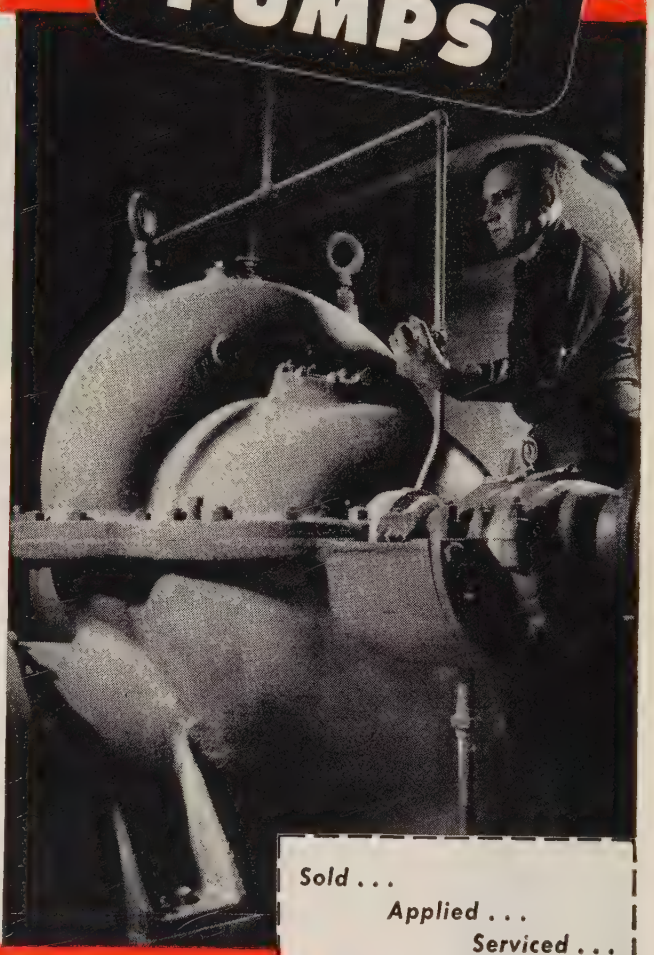

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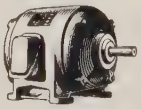

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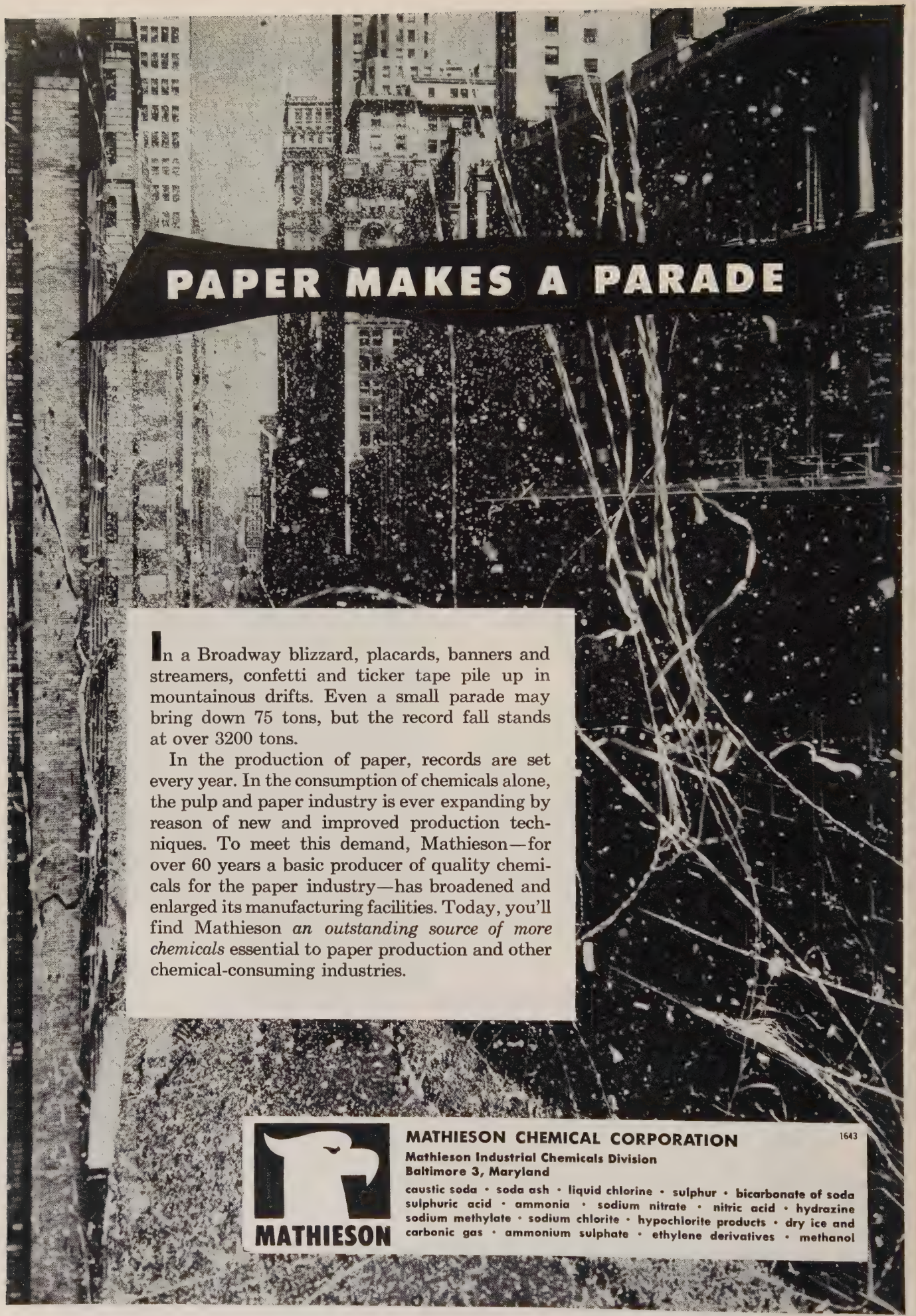

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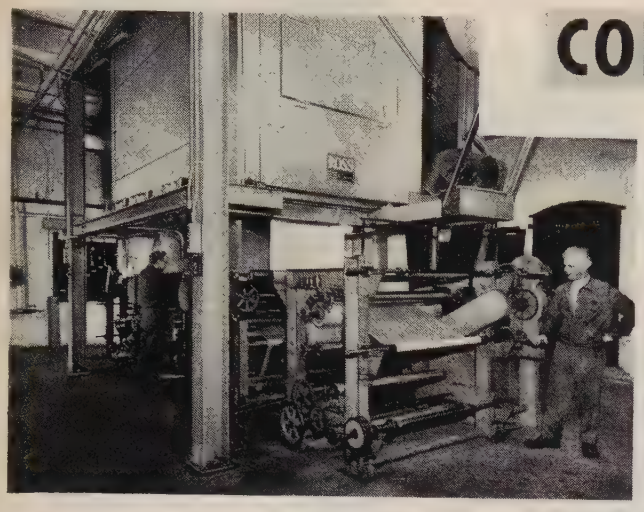

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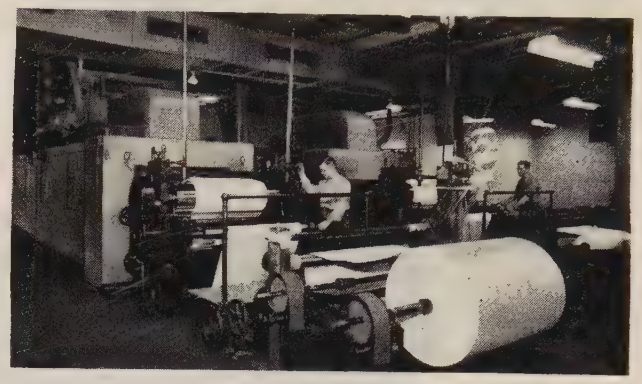

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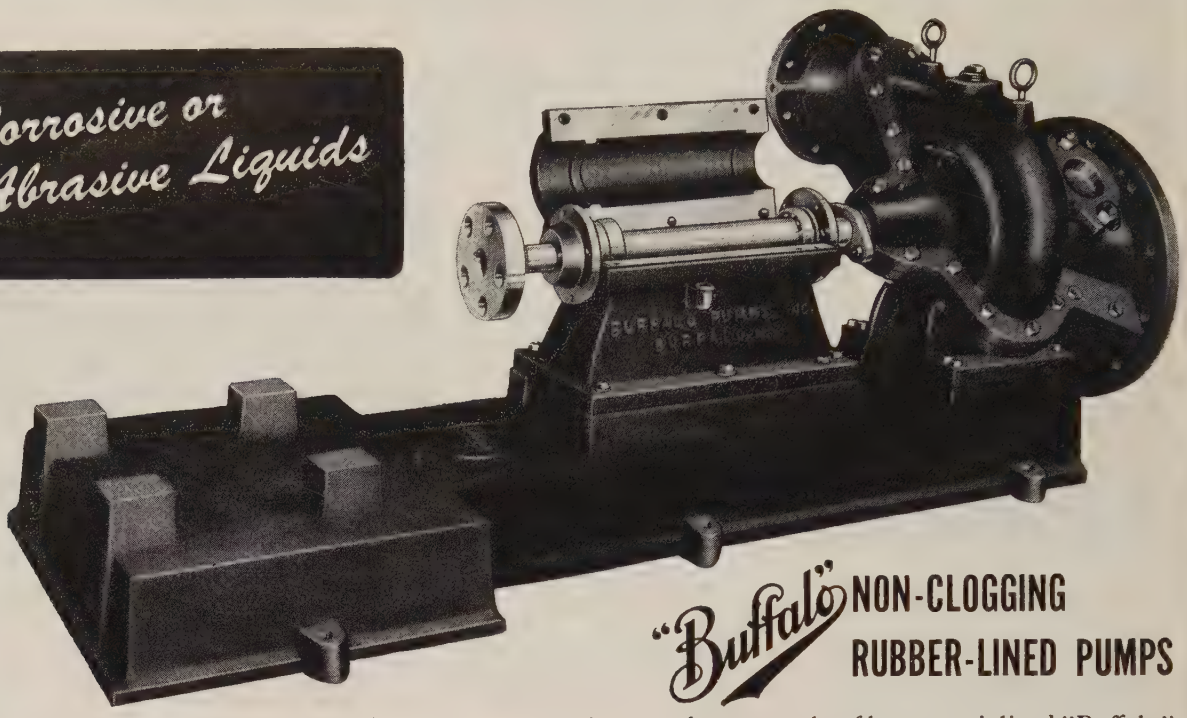

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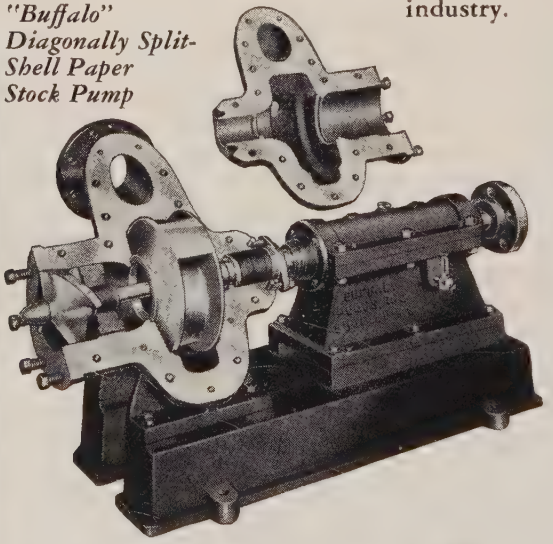

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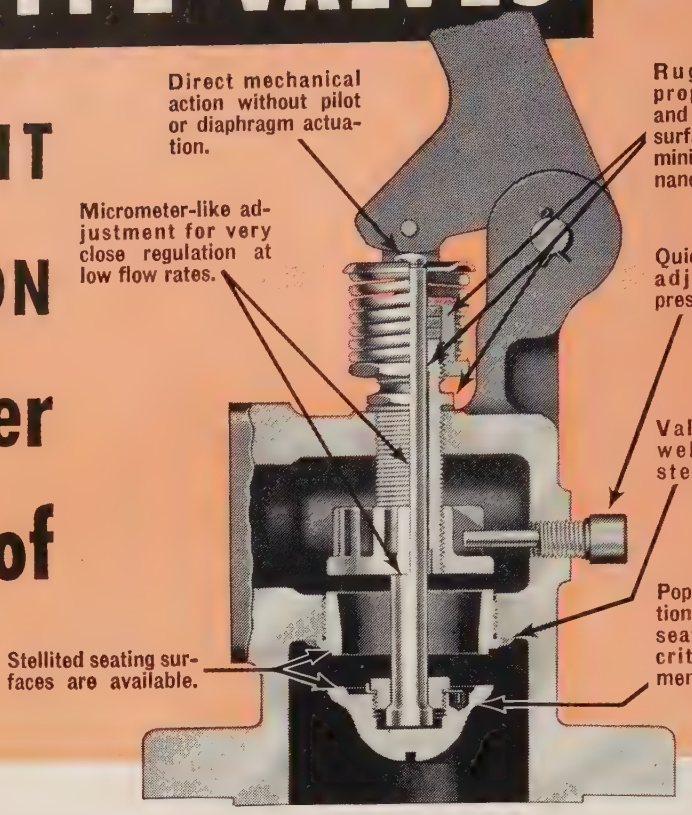
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Quick and simple adjustment of pressure control.
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Poppet construction assures tight seating without critical adjustment.

Note carefully the important advantages pointed out on the illustration above. You will see why Diamond Poppet Type has proved its superiority by many years of successful operation on the most difficult jobs.

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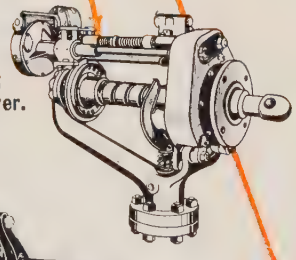

Diamond Model IR
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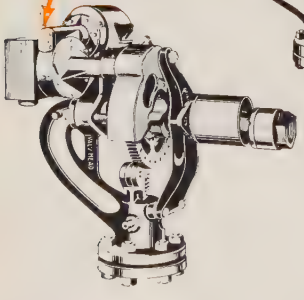

Diamond Model G9B
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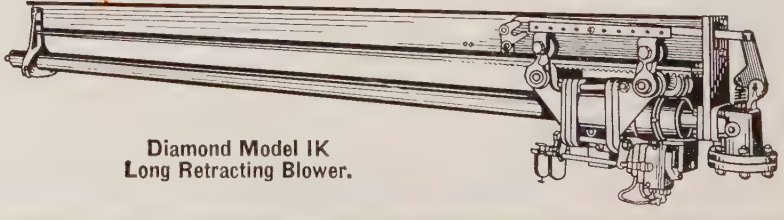

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Paperboard Drying Investigation by Means of an Experimental Drying Machine

STANLEY F. SMITH and B. W. ATTWOOD

An experimental drying machine is described on which moist paper or paperboard may be dried by a process closely matching that which takes place on the cylinder driers of paper and board machines. The main variables of drying, eleven in all, are under close control, and the effect on drying rate or sheet properties by varying each independently may be studied. The performance of almost any proposed drier part design may be evaluated. Preliminary studies of the effect of drier felt tension, air conditions in pockets of driers (saturation and velocity over sheet), spacing of cylinders, cylinder diameter, machine speed, and types of drier felt on drying rate are described. The possibilities of the machine as a research tool are discussed, also, the information the preliminary results throw on the mechanism of drying. Methods of measurement of sheet and felt tensions on paper or board machines, and a method used for measuring air conditions in the pockets of drier parts of board machines, are described.

THE work described in this paper has been carried out on an experimental drying machine which subjects pieces of moist paper or paperboard (usually from the press section of a paper or board machine) to a drying process closely simulating that taking place on the cylinders of a paper or board machine drier section. Each element of area of a sheet of paper or board on such a section is dried by the following sequence of events.

1. Contact is made by one face of the sheet with a heated drier surface for a certain time and with a certain pressure. During this time a drier felt presses on the opposite face of the sheet with about the same pressure as the contact pressure between sheet and cylinder.
2. The element of area then travels through air of a certain temperature and moisture content for a certain time. The velocity of the sheet relative to the air (and vice versa) is approximately sheet speed.
3. Contact is then made by the opposite face of the sheet with a heated drier surface, conditions being otherwise as (1) above.
4. The ventilating process described in (2) is then repeated.

A certain amount of drying has been accomplished by the four successive events listed above, and the cycle is repeated a sufficient number of times for the sheet to be dried as completely as required.

An examination of this process discloses a considerable number of variables which are likely to have an effect on the drying rate and which may have an effect on the properties of the dried sheet (strength, shrinkage, flatness, etc.). Eleven of these, which probably cover the main variables, are listed below. (The variables listed do not include those concerning conditions inside the drier, the whole of these appearing in the single factor of drier surface temperature.)

1. Length of time sheet is in contact with drying surface during each half-cycle.
2. Length of time sheet is clear of drying surface during each half-cycle.
3. Number of drying cycles.
4. Temperature of drier surface.
5. Pressure of sheet on drier surface.
6. Pressure of felt on sheet.
7. Temperature and moisture content of air surrounding sheet.
8. Velocity of air over sheet.
9. Type of sheet being dried (including variables of composition and basis weight).
10. Type of drier felt.
11. Sheet tension may be a significant variable in its own right, quite apart from its effect on (5) above.

There can be no doubt that a reasonably complete theory of the drying process, or a good technical knowledge of it, should be able to set out the effect of these variables so that the best drier part design and operating conditions for any particular purpose could be determined. An acquaintance with the literature on drying on heated cylinders, including two recent literature surveys by Burstein (*1*) and Thomas (*2*) shows that this desirable state of affairs does not yet exist, few consistent data being available and a great deal of conjecture surrounding the subject, this being so in spite of the great number of articles and papers which have been and are being published.

In the authors' view, this arises in the main from the difficulty of carrying out experimental studies on paper and board machine drier sections which do not lend themselves to operation as pieces of apparatus with the variables under control.

An attempt to simulate the drying process with at least some of the variables under control and thus to study their effect was made by Burstein using an experimental apparatus (*1*). This very interesting pioneer work produced many experimental results although it appears that control of several important variables was not achieved; also, the rather high variability of the results from the apparatus prevents close conclusions being drawn.

The apparatus used for the work described in the present paper is believed to have almost all the variables under good control, also reproducibility of results is very good indeed, so that quite small differences in drying curves are significant. The apparatus has been fully described in a recent paper by Attwood and Smith (*3*) so that only a brief description will be given here.

STANLEY F. SMITH, Manager, and B. W. ATTWOOD, Assistant, Research Dept., St. Anne's Board Mill Co. Ltd., Bristol, England.

DESCRIPTION OF APPARATUS

A stationary steam-heated drier with a convex cylindrical forward surface and having a copper face of high thermal conductivity is used. Surface temperature is regulated by the pressure of a saturated steam supply. A piece of moist sheet 5 by 3 in. is held in a light spring suspension immediately in front of the drier and

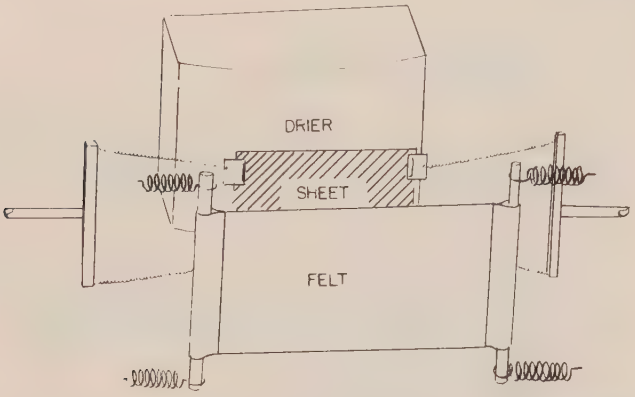

Fig. 1. Relationship of drier, sheet, and felt

a piece of drier felt (or in some cases other textile material) is held in a spring suspension a little further from the drier again. The relation of the drier, sheet, and felt when sheet and felt are off the drier are shown in Fig. 1.

The felt suspension is carried on a sliding carriage which moves toward or away from the drier. When the carriage slides forward to the "on" position, it takes the sheet forward with it (the very light suspension springs of the latter being very extensible) and this is so arranged that no increase in sheet tension occurs owing to the extra spring extension. Felt and sheet are then held against the drier surface with contact pressures dependent on the spring tensions (the springs are calibrated) and the radius of curvature of the drier face.

$$\text{Pressure on surface, p.s.i.} = \frac{\text{felt tension, lb./in. width}}{\text{cylinder face radius, in.}}$$

The appearance of the machine with the carriage in the "off" and "on" positions can be seen in Figs. 2 and 3. The number of drying cycles per minute, and the relative time the sheet is on and off the drier during each half-cycle are controlled by a variable speed d.c. motor driving a re-entrant cam of variable opening, which slides the movable carriage to and fro by means of a roller and leverage mechanism. The drive is shown in the lower part of Fig. 4.

The sheet is suspended from two horizontal arms which are mounted on short vertical spindles. The latter are rotatable through 180° by racks and pinions which are operated intermittently by a solenoid, the motion being transmitted from the solenoid to the rack and pinion assemblies by fine stranded steel cables. The solenoid is energized just after the sheet leaves the drier, the sheet rotating through 180° so that the opposite face comes in contact with the drier on the next movement forward of the felt and sheet. The solenoid is de-energized on the next outward movement again of the carriage, rotates back through 180°, and so on.

An air stream flows over the sheet during the time it is off the drier. Velocity, temperature, and moisture content of the air are controllable over wide ranges. Figure 5 shows the arrangement of the air supply. The moist sheet is protected from evaporation by means of sheet metal shrouds or holders during the whole of the time it is handled before and after the drying so that accidental moisture losses are small.

In this paper the results from the machine are set out in the form of drying curves—sample weight against number of half drying cycles (corresponding to number of drying cylinders on a machine drier section). They can, of course, be worked up in various ways as needed and can be expressed as drying rate against moisture content, for instance. The reproducibility of the machine itself is very high, the principal error arising from variation in basis weight of the samples. A technique of rejection of moist samples outside a small range of variation reduces this considerably, and the manner in which a number of results for each point on the drying curve are handled reduces it still further (*3*). The area of the sheet which is observed is 3 by 3 in., a 1-in. length

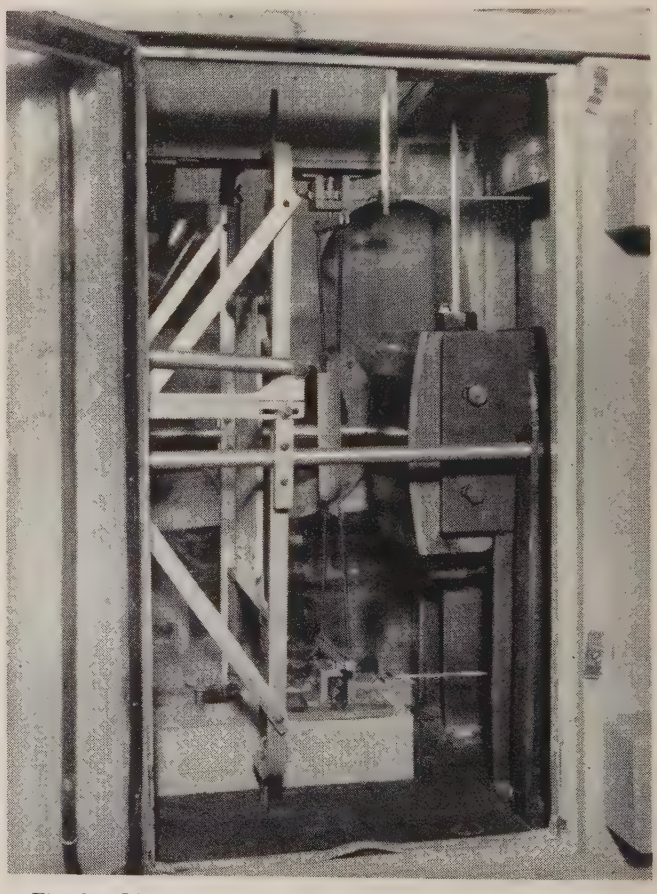

Fig. 2. Machine with felt and sheet in "off" position

at each end of the 5 by 3-inch sample which carries the suspending clips, being rejected.

WORK DONE BY THE MACHINE

The average drying rate found during a year or more's operation on a paperboard machine drier section has been compared with that given by the experimental

machine, the variables on the experimental machine being set to correspond with the average values on the commercial machine during the period of observation. This showed that the drying rates in the two cases were very close (*3*). Various other precautions and a discussion on the correspondence of conditions on commercial machines and the experimental machine are detailed in the same paper.

Table I. Felt Tension and Pressure on Sheet

	Felt tension, lb./in. width	*Corresponding pressure on sheet, p.s.i.*
(a)	1.3	0.043
(b)	2.8	0.093
(c)	9.4	0.31
(d)	20.0	0.66

The machine has been used to estimate the effect of a number of variables on drying rate, and observations on their effect on flatness of the dried sheets have also been made; only drying rate data are presented in this paper. It will be understood that the large number of possible variables (11) and the wide range over which many of them may be varied opens up a field of investigation which is very big indeed, and the work described is no more than a first exploration. A warning must be given against applying to all other conditions a conclusion which is undoubtedly valid over the range of conditions tried, at all events without further experiment. All the work described has been carried out on carton board of rather low basis weight (about 190 lb. per 500 sheets 30 × 40 ≡ 222 grams per square meter) and each separate investigation was carried out on one set of moist samples a large number of samples being first gathered so as to eliminate any variation due to differences in the material being dried. The material used for any two different investigations is usually not identical, although in general it is very similar in composition, basis weight, moisture content, etc.

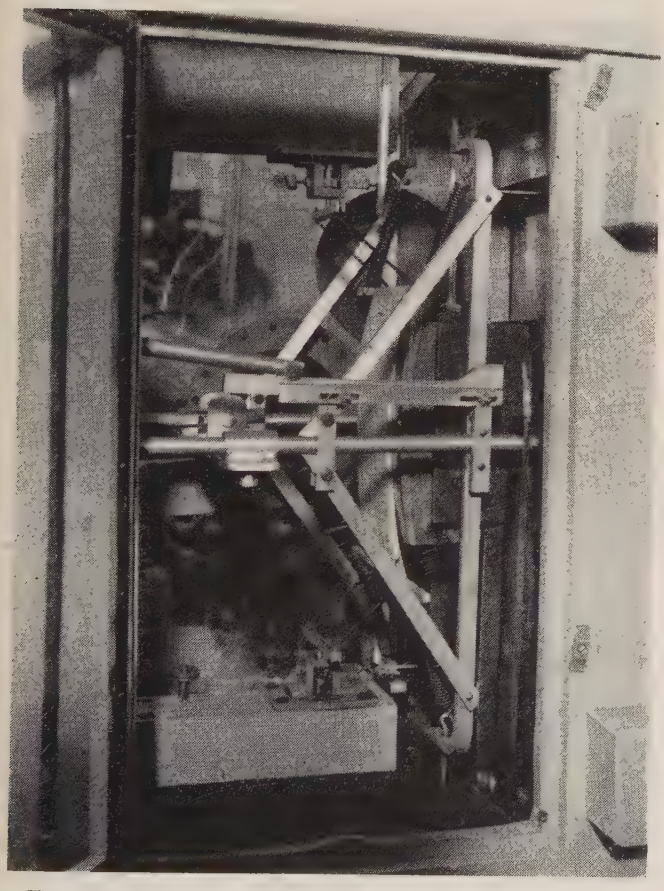

Fig. 3. Machine with felt and sheet in "on" position

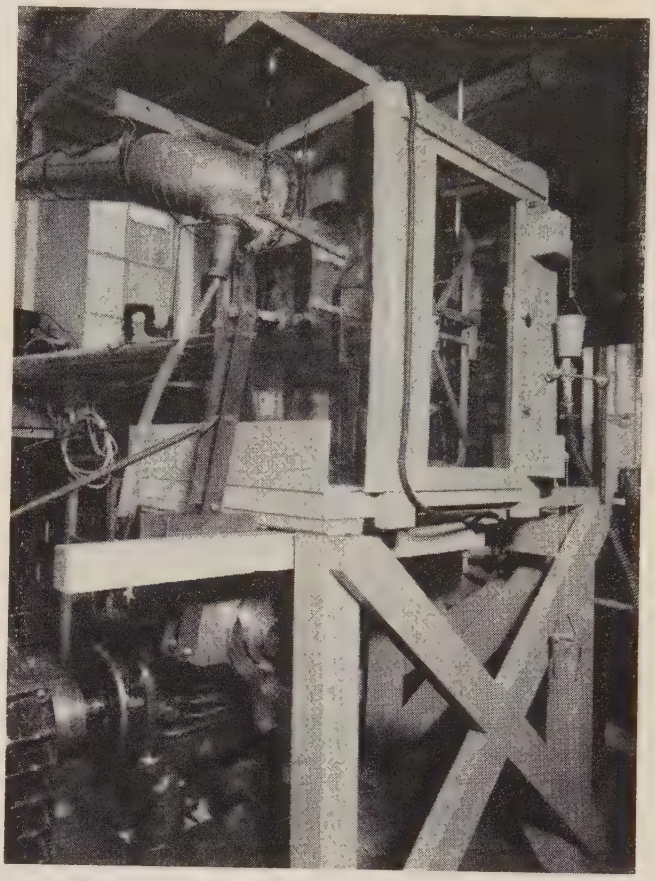

Fig. 4. Machine-drive shown in bottom left-hand corner

Effect of Drier Felt Tension on Drying Rate

Conditions were set on the machine to correspond to the following conditions on a commercial machine drier section:

Board speed, f.p.m.	240
Cylinder diameter, ft.	5
Free run between cylinders*, %	20
Cylinder temperature, °F.	250
Air conditions in cylinder pockets	
Dry bulb temperature, °F.	145
Wet bulb temperature, °F.	143.5
Air velocity, f.p.m. (as board speed)	240
Sheet tension, lb. per in. width	0.2

The drier felt used was heavy wool, 10 oz. per sq. ft.

Drying runs were made at felt tensions on the experimental machine corresponding to the following felt ten-

* The length of board between successive cylinders is called the "free run" in this paper, and per cent free run =

$$\frac{\text{Free run}}{\text{Contact length/cylinder} + \text{free run}} \times 100.$$

sions on 60-in. diameter driers† (Table I). The drying curves are set out in Fig. 6. It will be seen that drying rate is considerably increased by increasing the felt tension (and thus the contact pressure of the felt and sheet on cylinder). The increase is very apparent in the early part of the drying, and is maintained, rather than

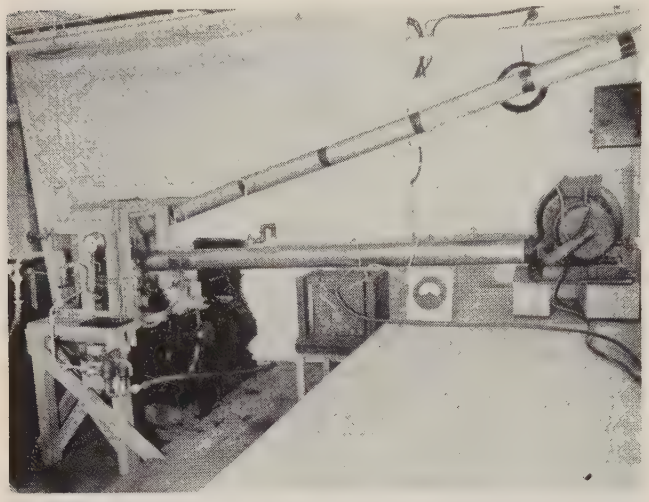

Fig. 5. Arrangement of air supply

added to, in the later stages of drying. The data in Table II are calculated from the curves. An appendix to this paper contains some particulars of felt tensions actually run on drier sections. The tensions normally used on making machines appear to come inside the range listed above.

Effect of Air Conditions in Cylinder Pockets on Drying Rates

Measurements of air conditions in the pockets of two regular machine drier sections showed that the condi-

Table II. Effect of Felt Tension on Drying Rate

Felt tension, lb./in. width	*Number of half-cycles (i.e., cylinders) required to dry to: 67% solids*	*75% solids*	*92% solids*
1.3	14.0	19.5	28.0
2.8	12.2	17.4	26.5
9.4	10.3	15.1	24.5
20.0	9.5	13.8	19.6
	Increase in drying rate (drying rate at 1.3 lb./in. felt tension taken as standard), % 60% solids	*75% solids*	*92% solids*
2.8	13	12	6
9.4	36	29	14
20.0	47	41	43

tions did not vary as much as might have been expected along the length of the drier section, the usual conditions being between dry bulb 160°F., wet bulb 145°F., and dry bulb 175°F., wet bulb 150°F., for the greater part of the length. An account of the method used is given in the Appendix. Although only a few runs have been made on the experimental machine to examine the effect of air conditions, the results seem highly significant, especially insofar as they bear on the theory of the drying process.

Two runs were made with the following air conditions: (1) dry bulb 145°F., wet bulb 143.5°F.; and (2) dry bulb 145°F., wet bulb 90°F., These conditions were chosen at an early stage of the work when measurements

Table III. Effect of Dry Air on Drying Rate

	Number of half-cycles (= drying cylinders) to dry to: 60% solids	*75% solids*	*92% solids*
Moist air	10.5	16.8	26.6
Dry air	9.2	13.6	19.7
Increase in drying rate owing to dry air, %	14	24	35

of air conditions in the drier pockets of regular machines had been made with mercury in glass wet and dry bulb thermometers in air withdrawn from the machine by means of a centrifugal pump and tube. An error owing to cooling was present, the air appearing cooler and more nearly saturated than it actually was, and the moister air (145°F. dry bulb, 143.5°F. wet bulb) was arranged to match what were thought to be average machine conditions. Actually the conditions on the commercial machine are similar to those listed earlier which were measured accurately by an improved method. There is, of course, a very great difference in the saturation of the two qualities of air, the first being about 96% R.H. and the second about 12% R.H.

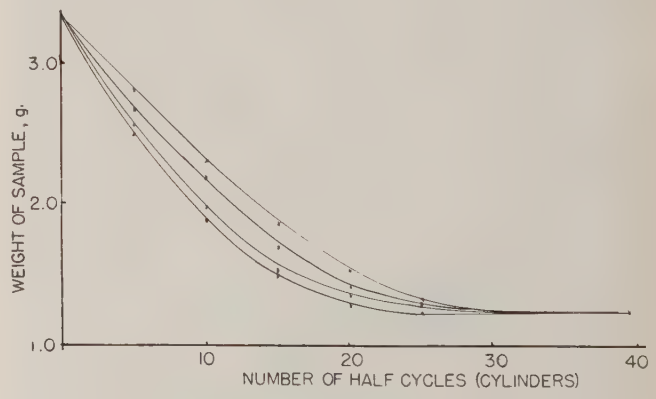

Fig. 6. Effect of felt tension on drying rate

Solid content = 36.6%. Top curve = 1.3 lb./in. felt tension. 2nd curve = 2.8 lb./in. felt tension. 3rd curve = 9.4 lb./in. felt tension. 4th curve = 20.0 lb./in felt tension.

Other conditions were kept constant at the equivalent of:

Board speed, f.p.m.	240
Cylinder diameter, ft.	5
Free run between cylinders, %	27
Cylinder temperatures, °F.	250
Air velocity, f.p.m.	240
Felt type, wool, oz.	10
Felt tension (5-ft. diameter driers), lb. per in. width	2.8

The drying curves are shown in Fig. 7. It will be seen that the drying rate is definitely higher with the drier air. The data in Table III are derived from the

† It will be appreciated that the felt tensions actually set on the experimental machine are *half* those listed, since the radius of curvature of the experimental drier face is 15 in., i.e., half the radius of a 5-ft. diameter drier, and the pressure developed is inversely proportional to the radius.

curves. The increase in drying rate is very small, however, in comparison with the relative drying capacity of the two supplies of air. The ratio of the drying capacity of the dry to the moist air (that is, the relative initial drying rate of moist board suspended in (1) stream of the dry air and (2) stream of the moist air and dried

Table IV. Effect of Dry Air on Drying Rate—14.5% "Free Run"

	Number of half-cycles (= drying cylinders) to dry to:		
	60% solids	*75% solids*	*92% solids*
Moist air	10.8	16.8	27.0
Dry air	9.6	14.5	21.9
Increase in drying rate owing to dry air, %	12.5	16	23

solely by the air stream) is approximately 20:1. It thus appears that an increase of 2000% in the drying capacity of the surrounding air has resulted in only 12% increase in drying rate in the early stages and about 36% increase in over-all drying rate. It would, of course, be quite impracticable to reduce the saturation in the machine cylinder pockets to anything like that of the drier air of these runs.

Another pair of runs with the conditions as above but with a free run between cylinders of 14.5% gave a very similar result, but the increase in drying rate was somewhat less (see Table IV).

Effect of Air Velocity on Drying Rate

An increase of air velocity in the experimental machine from 120 to 240 f.p.m. has been found to give only an insignificant increase in drying rate, and an increase

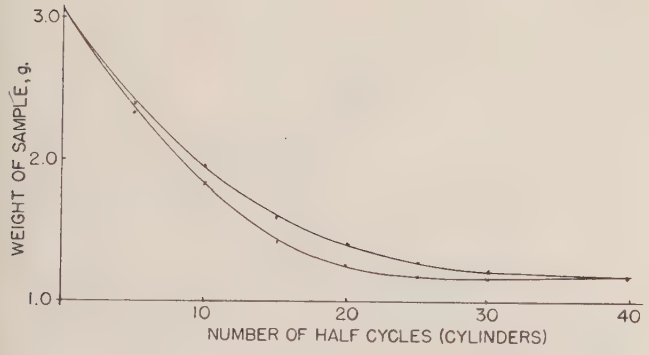

Fig. 7. Effect of air conditions on drying rate

Solid content = 37.7%. Top curve = air-dry bulb 145°F. and wet bulb 143½°F. 2nd curve = air dry bulb 145°F. and wet bulb 90°F.

from 240 to 480 f.p.m. gave no increase at all. When, however, moist board was suspended in an air stream and dried solely by it, the air flowing parallel to its surface, the drying rate was found by the authors to depend on the air velocity as described by other workers. The relation is usually stated to be approximately, drying rate = $kV^{0.6-0.8}$. The authors have found the coefficient to be 0.57 to 0.71 over the range of 300 to 2000 f.p.m. (This refers to the initial constant rate drying period which was very well defined.)

Effect of Spacing of Cylinders on Drying Rate

The spacing of cylinders on commercial machines is usually such that the "free run" is round about 20%. Spacings ranging from 30 to 14% are sometimes met with which are usually arranged by having the upper row of cylinders higher or lower in relation to the lower row. The effect of raising the top row is to increase the

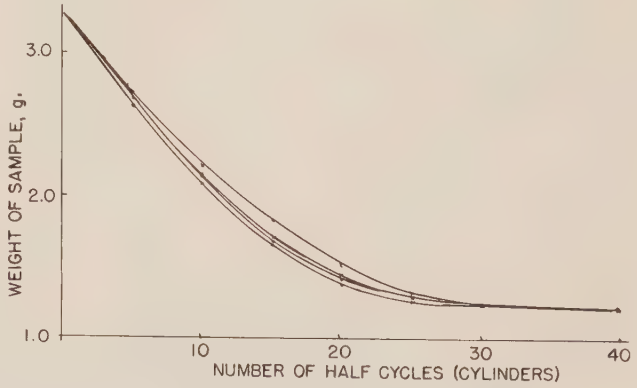

Fig. 8. Effect of cylinder spacing on drying rate

Solid content = 36.6%. Top curve = 14.5% free run. 2nd curve = 20% free run. 3rd curve = 27% free run. 4th curve = 38% free run.

length of sheet between driers (the "free run") and to decrease the contact length on the drier surface to a less extent.

A series of four runs was made on the experimental machine corresponding to the spacings shown on Table V which were calculated from actual or proposed layouts (cylinder diameter = 5 ft.).

The other conditions corresponded to:

Board speed, f.p.m.	240
Cylinder temperature, °F.	250
Air conditions	
Dry bulb, °F.	145
Wet bulb, °F.	143.5
Velocity, f.p.m.	240
Felt type, wool, oz.	10
Felt tension, lb. per in. width	2.8

The drying curves are shown in Fig. 8. A progressive increase in drying rate is shown with widening of the spacing. The magnitude of the effect is not great, however, amounting overall to about 15% (14.5 to 38% free

Table V. Spacing of Cylinders for Trial Runs

	Contact length/cylinder, ft.	*Free run, ft.*	*Free run, %*
(a)	10.94	1.86	14.5
(b)	10.48	2.64	20
(c)	10.00	3.70	27
(d)	9.40	5.74	38

run) and most of it is seen in the first step, i.e., in changing from 14.5 to 20% free run. Other runs with drier air (dry bulb 145°F., wet bulb 89°F.) showed much the same thing, the increase in drying rate with wider spacing not being noticeably greater than in the series above.

Effect of Cylinder Diameter on Drying Rate

To investigate this point three hypothetical drier

sections were considered having cylinders of 2 ft. 6 inches, 5 ft., and 10 ft., respectively. As a first design it was assumed that the spacing of the cylinders in each case would follow a purely practical rule (based on safety considerations and an actual layout) of 7.86 in. clearance between successive cylinders. This leads to

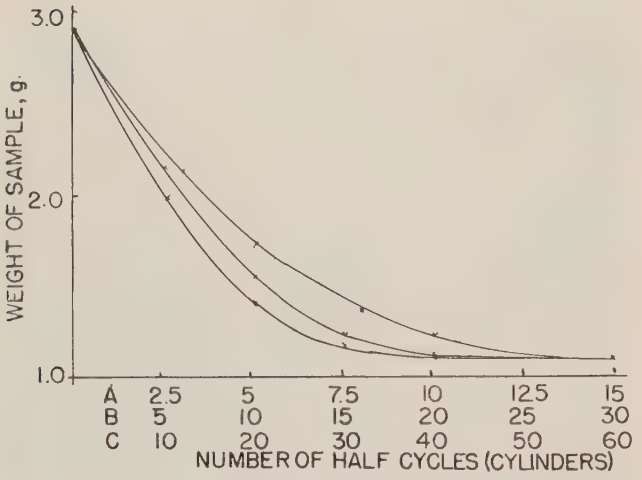

Fig. 9. Effect of cylinder diameter

Solid content = 37.5%. Top curve = 10-ft. diam. cylinders. 2nd curve = 5-ft. diam. cylinders. 3rd curve = $2^1/_2$-ft. diam. cylinders.

A—10-ft. diam. cylinders. B—5-ft. diam. cylinders. C—$2^1/_2$-ft. diam. cylinders.

different per cent free run of the sheet between the cylinders in the three cases (see Table VI). A felt tension of 8.8 lb. per in. width was assumed in each layout. The pressure of the felt on the sheet will be different in the three cases (being inversely proportional to the

Table VI. Different Cylinder Diameters—Details of "Free Run"

Diameter of cylinder, ft.	2.5	5	10
Contact length, ft.	4.75	10.48	22.44
Free run, ft.	1.92	2.64	3.68
Free run, %	29	20	14

cylinder radius), the 10-ft. diameter cylinder having the least pressure, and the 2-ft. 6-in. the most. The pressures are listed in Table VII.

A board speed of 240 f.p.m. was assumed in each case. Since the cylinders are of different diameter, and the total board lengths per cylinder (contact length + free run) also different, the half-cycles per minute to be set on the experimental machine are also different. Details are set out in Table VII. Other conditions (constant throughout) were:

Cylinder temperature, °F.	250
Air conditions	
Dry bulb, °F.	165
Wet bulb, °F.	145
Velocity, f.p.m.	240
Sheet tension, lb. per in. width	0.2
Felt type, wool, oz.	10

Results of the three runs are shown in Fig. 9. To set out the results in true relation to one another as drying rates, the appropriate scales are used for the abscissas, twice the number of 5-ft. diameter cylinders being needed to provide the same drying area as that number of 10-ft. diameter cylinders and so on. The graphs are thus directly comparable. It is clear that there is a substantial difference in drying rate in the three cases, the 2-ft. 6-in. cylinders having the highest drying rate and the 10-ft. the lowest. The result was analyzed by making further runs with the machine.

Table VII. Different Cylinder Diameters—Cycles/Min.

Cylinder diameter, ft.	*Pressure of felt on sheet, p.s.i.*	*Half cycles/ min.*
2.5	0.586	36.0
5	0.293	18.3
10	0.147	9.19

Free Run. Two runs were made, the first exactly as for the first 2-ft. 6-in. diameter cylinder run except that 20% free run was used (with the corresponding small adjustment in half cycles per minute). The drying curve was almost exactly identical with the original run with 29% "free run." The second was as for the first 10-ft. diameter cylinder run except that the "free run" was adjusted in this case also to 20% (with the necessary small adjustment in half-cycles per minute). Here again the drying curve was almost indistinguishable from the original run with 14% "free run." It is now apparent that the difference in "free run" has had

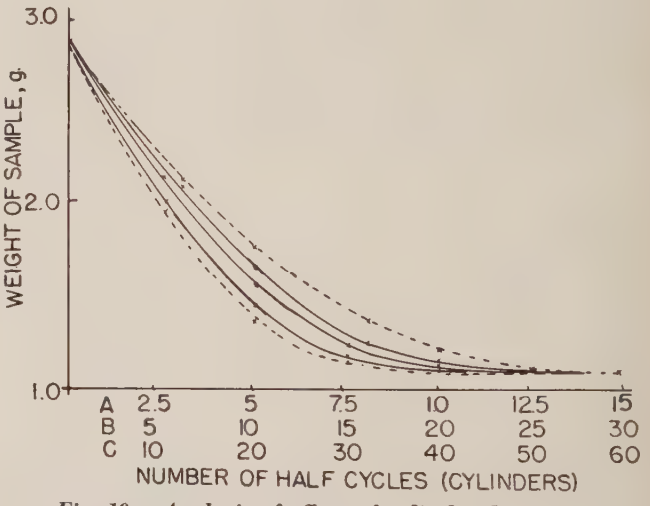

Fig. 10. Analysis of effect of cylinder diameter

Solid content = 37.5%.

3 Full Line Curves	Free Run	Felt Pressure
Top curve = 10 ft. diam. Middle curve = 5 ft. diam. Bottom curve = $2^1/_2$ ft. diam.	20%	0.293 p.s.i.
Dotted Curves	**Free Run**	**Felt Pressure**
Top curve = 10 ft. diam.	14%	0.147 p.s.i.
Bottom curve = $2^1/_2$ ft. diam.	29%	0.586 p.s.i.

A—10-ft. diam. cylinders. B—5-ft. diam. cylinders. C—$2^1/_2$ ft. diam. cylinders.

practically no part in causing the difference in drying rates of the 2-ft. 6-in., 5-ft., and 10-ft. diameter cylinders.

Pressure of Felt on Sheet. Two more runs were made, identical with the two just described except that the pressure of the felt on the sheet was set at the same figure in each case—0.293 p.s.i. (the figure for 5-ft. diam-

eter cylinders). This means that the 2-ft. 6-in. diameter cylinder felt pressure was reduced, and the 10-ft. diameter cylinder felt pressure increased. The two drying curves are set out in Fig. 10, together with the original 5-ft. diameter cylinder run (which is also at 20% free run and 0.293 p.s.i. felt pressure). The original 2-ft. 6-in. and 10-foot diameter runs have been dotted in for comparison. It is clear that felt pressure has had a considerable part in causing the difference in drying rates of the 2-ft. 6-in., 5-ft., and 10-ft. diameter cylinders. However, it is not the sole cause since there is still some difference in drying rates, the 2-ft. 6-in. still being the highest and the 10-ft. the lowest. This can now only be due to the frequency of the drying cycle, and it can be seen that, under these conditions and over this range, the more rapidly the drying cycle is repeated, the higher the rate of drying. The magnitude of this effect is not very great however.

Effect of Machine Speed on Drying Rate

Three runs were made corresponding, respectively, to 120, 240, and 480 f.p.m., the other conditions being:

Cylinder diameter, ft.	5
Cylinder temperature, °F.	250
Air conditions	
Dry bulb, °F.	165
Wet bulb, °F.	145
Velocity	120 f.p.m. for 120 f.p.m. run 240 f.p.m. for 240 f.p.m. run 480 f.p.m. for 480 f.p.m. run
Drier felt	
Type, wool, oz.	10
Tension, lb. per in. width	8.8
Sheet tension, lb. per in. width.	0.2

Results are shown in Fig. 11. (Abscissas are arranged as

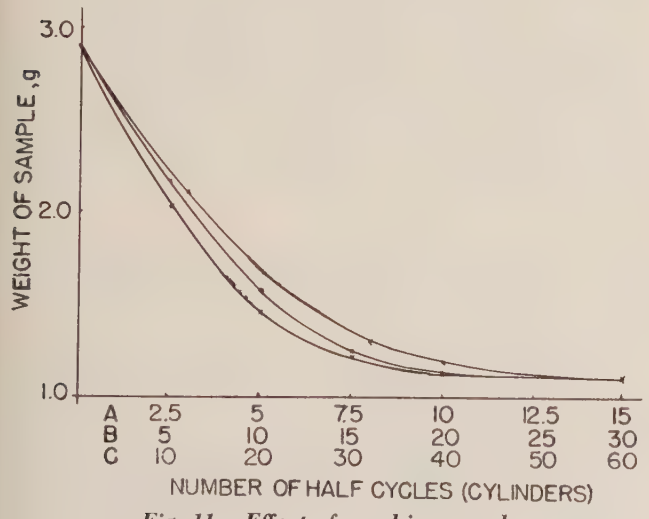

Fig. 11. Effect of machine speed

Solid content = 37.5%. Top curve = m/c speed = 120 f.p.m. 2nd curve = m/c speed = 240 f.p.m. 3rd curve = m/c speed = 480 f.p.m.
A—10-ft. diam. cylinders. B—5-ft. diam. cylinders. C—$2^1/_2$-ft. diam. cylinders.

described in the previous section so that drying rates are directly comparable. It will be seen that the drying rate has increased with the speed, a fourfold rise in speed (from 120 to 480 f.p.m.) increasing the rate about 30%.

This result can be analyzed in the same way as that in the previous section. In this case the effect of the change in air velocity was examined by means of two additional runs. It was found that a 480 f.p.m. drying curve with the air stream flowing at 240 f.p.m. was identical with the original having the air stream at 480 f.p.m. A small difference was shown between 120 f.p.m.

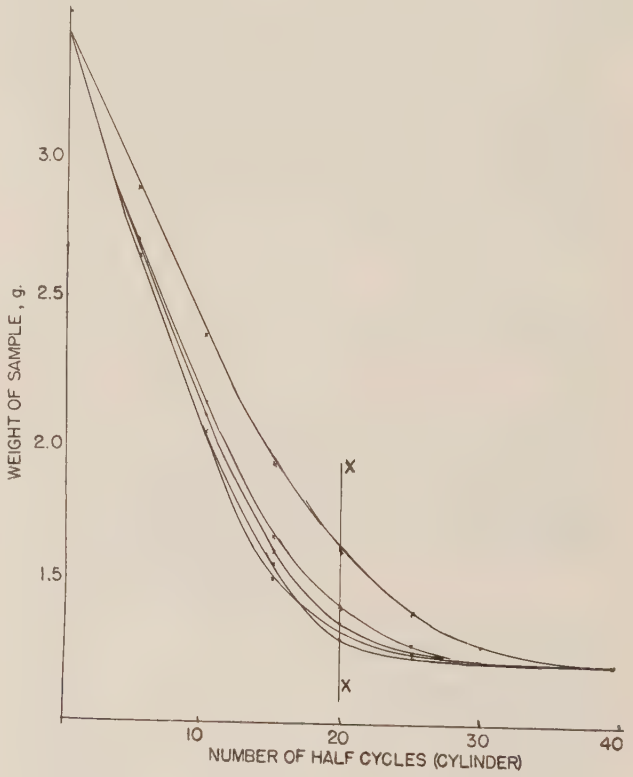

Fig. 12. Effect of the type of drier felt

Solid content = 33.3%.
At x-x: top curve = tinfoil faced linen; 2nd curve = cotton asbestos; 3rd curve = wool, M.G., and cotton (all curves coincide); 4th curve = wire; 5th curve = linen.

runs with the air at 120 f.p.m. (the original run) and air at 240 f.p.m., the drying rate being very slightly higher for the latter. When the three curves, with the influence of air velocity removed, are plotted, the same result emerges as in the previous section—the more frequent repetition of the drying cycle has increased the drying rate. (Actually the board used for the runs in the previous section—that on the effect of cylinder diameter—and in this, was the same, so that the three full line curves in Fig. 10 also represent the machine speed effect with the influence of air velocity removed, as a moment's consideration will show.)

It is generally believed that drying rate falls off at high machine speeds—Montgomery (*4, 5*) and MacNaughton (*6*)—and this is not necessarily in conflict with the results described above—there may be an optimum frequency of repetition of the drying cycle. The effect of basis weight and type of product dried may also be factors, and more experimental work will be needed before this question can be settled.

Effect of Cylinder Temperature

The machine, as at present fitted up, can operate with a cylinder temperature range of 220 to 270°F., and it is

intended to arrange a higher pressure steam supply to increase the maximum temperature considerably. It is then proposed to examine the effect of temperature in some detail. Runs over the 220 to 270°F. range show an approximately linear relation between over-all drying rate (pounds of water evaporated per square foot per hour and taking the whole drying process, say 35 to 92% solids) and cylinder temperature. The absolute drying rates and the slope of the characteristic are somewhat greater than on the TAPPI mean drying characteristic for boards (Montgomery (*5*)) but the conditions do not compare very closely, most of the TAPPI results being on unfelted machines, and a considerable (and unknown) differential existing between steam temperature and cylinder temperature on the cast iron cylinders of the machines surveyed.

Type of Drier Felt

Runs were made with the following drier felts or other woven materials.

Linen	Thin cloth, approx. 1/2 oz. per sq. ft.
Nickel wire cloth	160 mesh per inch, approx. 1 1/2 oz. per sq. ft.
Woolen M.G. felt	approx. 5 3/4 oz. per sq. ft.
Cotton drier felt	approx. 8 oz. per sq. ft.
Woolen drier felt	approx 10 oz. per sq. ft.
Cotton-asbestos felt	approx. 9 oz. per sq. ft.
Linen faced with tinfoil	linen 1/2 oz. per sq. ft. as above tinfoil 0.0004 in. thick = 0.08 oz. per sq. ft.

Other conditions were:

Board speed, f.p.m.	240
Cylinder temperature, °F.	250
Air conditions	
Dry bulb, °F.	165
Wet bulb, °F.	145
Velocity, f.p.m.	240
Cylinder diameter, ft.	5
Free run, %	20
Felt tension, lb. per in. width	8.8
Sheet tension, lb. per in. width	0.2

The drying curves are shown in Fig. 12. The main points seem to be: tinfoil-faced linen (which is impermeable to steam or water) considerably reduced the drying rate especially during the early stages of drying; very permeable materials showed the highest drying rates (linen and fine wire cloth), also the cross-over of these two curves may be significant; heavy woolen drier felt, woolen M.G. felt, and cotton drier felt gave almost identical drying curves.

SIGNIFICANCE OF RESULTS

It seems that it should be perfectly possible to make a survey of the effect of the main variables of drying on drying rates using this or similar machines, and although the matter is outside the scope of the work described in this paper, it also seems quite feasible to study the effect of the different variables on dried sheet properties. This type of machine does, in fact, appear to provide a useful tool for studying the drying process.

It also seems very possible that the necessary experiments can be designed to work out the mechanism of the drying process with much more certainty than exists at present. To the authors, although it is no doubt much too early yet to draw definite conclusions, the results from the runs carried out under the conditions described do not at all suggest a ventilation drying process with the sheet always below the boiling point of water (this refers particularly to the early stages of drying). Calculation from the data indicates that only a small proportion of the water can be evaporated by conversion of sensible into latent heat when the sheet is between cylinders, as other workers have noted (Sherwood, Gardner, and Whitney (*7*)). The relatively small effect of air humidity and velocity on drying rates, in the early stages of drying especially, suggests that evaporation between cylinders makes only a minor contribution to the drying rate. A two-process mechanism appears probable—heat transfer to the sheet and generation of steam at atmospheric pressure or slightly above during the contact period, the steam being lost as such from between sheet and cylinder or sheet and felt, or by condensation in part in the felt. This process would need to account for about 80% of the water removal in the early stages, and moisture loss between driers by the process described above would account for the remainder. Some observations of a defect called "blistering" occasionally met with in board manufacture are pertinent—a board with a relatively impermeable top and bottom surface may develop blisters during drying, undoubtedly caused by steam generation within the sheet indicating that the sheet as a whole is at boiling point or slightly above. Another point is that the constant rate period of drying down to a first critical moisture content is hardly in evidence at all in these curves, a falling rate being apparent from the outset. It seems to the authors that the condition causing falling rate of heat transfer, even before the kinetics of drying produce an unsaturated surface, may very well lie in the development of cockling or micro-cockling of the sheet, or possibly the development of still smaller surface irregularities, all of them due to shrinkage or swelling phenomena or recovery of the sheet from the flattening effect of the machine presses. A reduction in the effective contact area between sheet and cylinder and an increase in the mean distance between sheet and cylinder would result; these factors constitute the main resistance to heat flow (Montgomery (*8*)) and changes in them would be highly critical.

APPENDIX

Sheet and Felt Tension Measurement

At an early stage of the work, sheet and felt tensions on actual drier sections were required. The machines at this mill have a spring-mounted roll as the take-off roll from the drying cylinders, and it was not difficult to calibrate the springs so that sheet tension at this point could be read off. The tensions of the wet sheet leading on to the driers, and the drier felts, were not so easily determined. It was eventually found possible to measure them satisfactorily by making use of the properties of a catenary.

A sheet or felt takes up the shape of a catenary (that of a hanging chain) between two carrying rolls, provided the stiffness of the sheet or felt is not sufficient to distort the curve. With a wet sheet or a fairly long span of felt, close agreement with catenary form can safely be assumed.

The "dip" of the sheet or felt between two carrying rolls depends upon its tension: the greater the tension the smaller the dip. Machine men and others com-

monly use this property to estimate the tension of sheet draws, the dip or sag of the sheet between two rolls giving a visual estimate of tension. If the dip and span of the catenary and the weight per unit area of the sheet or felt are known, the tension may be calculated. The method requires only very simple apparatus and can be applied to many positions on a paper or board machine where tensions could otherwise only be measured by putting in special equipment.

Calculation from "dip" of Catenary

The equation of the catenary is:

$$y = a \cosh \frac{x}{a}$$

$$= a \left(1 + \frac{x^2}{\lfloor 2a^2} + \frac{x^4}{\lfloor 4a^4} + \frac{x^6}{\lfloor 6a^6} \text{ etc.}\right)$$

The terms in the bracket form a diminishing series, and when the dip d is 10% of the total span or less (which is the case on all sheet and felt spans so far examined) all terms except the first two may be neglected with negligible error. The equation is then:

$$y = a \left(1 + \frac{x^2}{2a^2}\right)$$

now

$$y = a + d = a \left(1 + \frac{x^2}{2a^2}\right)$$

$$= a + \frac{x^2}{2a^2}$$

therefore

$$d = \frac{x^2}{2a} \text{ and } a = \frac{x^2}{2d}$$

The tension T at any point of the catenary $= wy$ (T = tension per unit width) (w = weight per unit area of felt or sheet)

$$T = wy$$
$$= w(d + a)$$
$$= w \left(d + \frac{x^2}{2d}\right)$$

If d is small in comparison with $x^2/2d$ which is nearly always the case with sheet and felt spans,

$$T = \frac{wx^2}{2d}$$

The above working is for a horizontal span, but in some cases, especially with sheet spans, the only one offering itself for measurement of dip is considerably inclined. It has been shown by us that spans inclined up to 30° to the horizontal can be assumed with negligible error to be horizontal provided that the dip (the maximum value, measured at right angles to the inclined span) is not more than 2%, which is often the case with actual sheet and felt spans.

Instead of measuring the "dip," the angle of inclination of the ends of the span to its chord may be measured and the tension calculated from the inclination and the other data using a force diagram. For most sheet or felt spans the angle to be measured is very small, however, and the accuracy of this method is low, so that although it was used to a small extent, the tension was derived from the dip in most of the work.

Many felt and sheet tensions were measured with one or the other of the above methods and the following is a summary of the results.

Drier felt tensions ranged between 2 and 12 lb. per in. width. Two pounds per inch is a very slack felt, although felts are often run as slack as this, especially if they are inclined to run badly, to wrinkle, for example. The maximum tension at which felts can be run seems to be dictated by considerations such as roll stiffness rather than by felt strength and lasting qualities.

Sheet tension measurements described below were made on two *unfelted* two-tier drier sections in connection with work on drying rates on unfelted driers (not described in this paper). Tensions on felted drier sections are believed to be decidedly lower. The tensions of the moist sheet going on to the cylinders ranged between 0.6 and 3 lb. per in. width over a basis weight (in the dry state) range of 230 to 600 lb. per 500 sheets 30 × 40 (270 to 700 grams per square meter). The basis weight in the wet state is about 100/35 times these values. The tension followed the basis weight although with a considerable scatter, as might be expected. Dry end sheet tensions ranged from 5 to 10 lb. per in. and followed the measured tensile strength of the sheet with a considerable scatter. The ratio of sheet tension to tensile strength was about 1:15 for the mean characteristic drawn through the points on a sheet tension/tensile strength plot.

Sheet tensions are, of course, set by the machine man or drier man, and the usual practice is probably to run not far from the maximum tension the sheet will stand without an undue number of tension breaks. The 15 to 1 ratio no doubt takes care of such things as weak edges, section speed variations, etc.

Measurement of Air Conditions in Drier Pockets

A very satisfactory hygrometer was constructed for this work, consisting of a $^7/_8$ in. diameter brass tube 11 ft. long having two chromel/alumel thermocouples mounted just inside one end. The couple nearer the end of the tube acts as the dry bulb unit. The second thermocouple acts as the wet bulb and is wrapped with fine cotton cloth, kept wet by a small bakelite water bottle mounted on the same end of the tube. The thermocouple strip is necked in on each side of the wetted portion to keep heat flow to a minimum. Each of the thermocouples is connected by the usual compensated leads, running inside the brass tube, to a changeover switch connected in its turn to a compensated cold junction galvanometer. When in use an air stream is drawn along the tube over the two thermocouples by a small centrifugal pump. The hygrometer has been checked against an accurate mercury in glass wet and dry bulb hygrometer, and the readings are satisfactorily close over the wide range of air conditions required in this work.

Measurements of air conditions in the cylinder pockets can be made without any particular difficulty, and reference has been made to some results on felted driers. These pockets are ventilated with air pipes running right across the machine (146 in. trim), and no marked gradients in air conditions across the machines were found. On unfelted machines (also with cross pipes) the air temperatures were decidedly lower, and very considerable gradients in air properties across the

machine were met with, temperature and absolute humidity being at a minimum at the edges. Maxima were not halfway across, being in general displaced toward the back side.

The conditions do not vary greatly, along the length of the machine for felted or unfelted driers after the first few cylinders, which show a rapid rise in air temperature and absolute humidity. The last few cylinders show somewhat drier air conditions than the remainder.

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The Deculator on a Kraft Paper Machine

A. W. DUSKIN and W. B. JENKINS

The Deculator for deaerating dilute paper stock before the headbox is described. A discussion is given of results obtained from a recent installation on a high-speed kraft paper machine equipped with a pressure headbox. Improvement in formation, prevention of foam, increased machine efficiency, increased drying efficiency, smaller basis weight variations in the machine direction, improvement in sheet smoothness, and small maintenance costs are the general results noted.

The presence of air in the suspension of fibers in the headbox of a paper machine, both entrained and dissolved, has long been recognized as having harmful effects on both paper machine operation and paper quality. The purpose of this paper is to present the experience of one kraft paper mill in the solving of this problem by the use of the Deculator.

The problem of air in the paper machine headbox has been especially troublesome since the trend has been to higher speeds and pressure-type headboxes. Ten years ago we installed a pressure-type headbox of our own design and after its installation it was felt that one of the contributing factors to surges on the wire and weight variations in the machine direction of the sheet was air and foam present in the headbox. About 4 years after the pressure-type headbox was installed it was determined that, due to the higher speeds we were running and the need for more water in the sheet, a larger fan pump was necessary. This new fan pump of 25,000 g.p.m. was installed and it was hoped at this time that because of its slower speed and larger capacity less turbulence and, therefore, less mixing of air would occur in the larger pump. This assumption proved to be in error as far as air in the stock was concerned, but we did gain the advantage of being able to run headbox consistencies much lower than before. At about this time (1946) the Clark & Vicario Co. became interested in the problem of deaerating dilute paper stock and we followed their work with much interest. The first installation of a full-sized Deculator was made in 1950, on a newsprint machine at the Three Rivers, Que., mill of Canadian International Paper Co. Other installations were later made on corrugating board, book, bond, and waxing, but the installation described in this paper was the first made on a high-speed kraft paper machine using a pressure-type headbox.

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THE PROCESS AND OPERATION

The Deculator process can be described briefly as the deaeration of the stock and white water between the fan pump and headbox. Stock and white water are introduced in the conventional way to the intake of the fan pump from the stuff box and wire pit. From the discharge of the primary fan pump a 36-in. line carries the diluted stock through a distribution header to a vessel maintained at a high vacuum. The vacuum in this receiver is maintained close to the saturation pressure corresponding to the boiling point of the stock being handled. From the header the stock is sprayed into the receiver through large nonclogging nozzles which whirl the stock at high velocity and discharge it against impingement targets, thereby breaking the air bubbles and separating the air from the fiber and water. A constant liquid level is maintained in the receiver from which the stock is pumped by the secondary fan pump to the headbox. Air is removed continuously from the receiver by a three-stage vacuum unit (including a precondenser, steam jet after condenser), and a two-stage vacuum pump. The com-

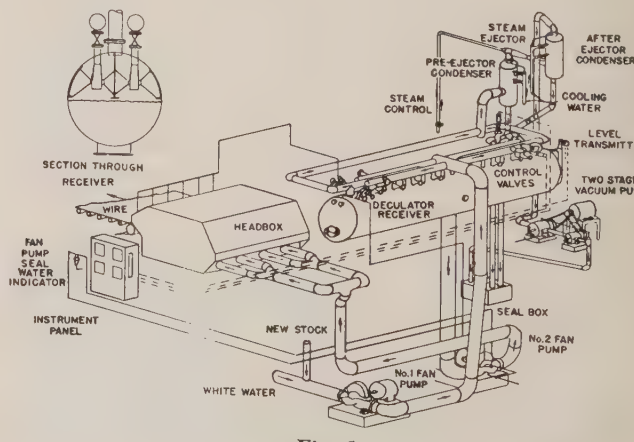

Fig. 1

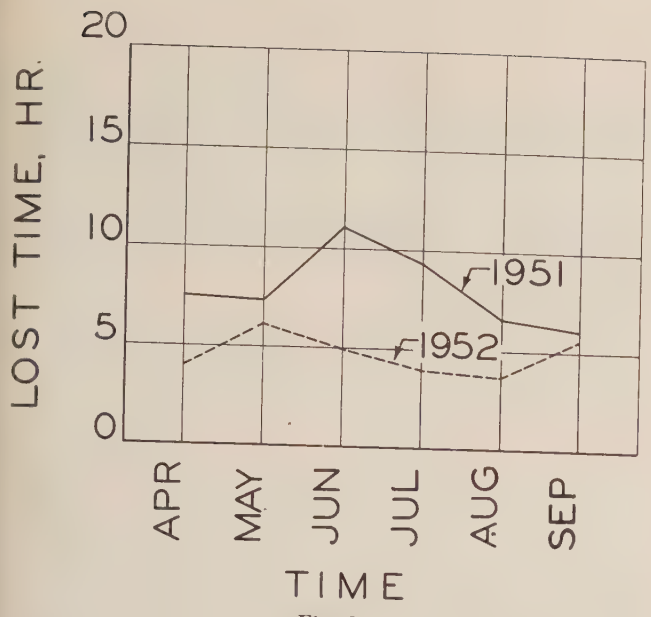

Fig. 2

plete process is under automatic control throughout, with liquid-level controllers and temperature and vacuum recorders mounted on a central instrument panel, together with signal lights and push buttons for the fan pumps and vacuum pumps.

For a fourdrinier machine producing an average of 250 tons per day in basis weights of 40 to 90 lb., the receiver vessel is 6 ft. in diameter by 30 ft. long. The vacuum pumps are driven by a 50-hp. motor and the secondary fan pump driven by a 250-hp. motor, has a capacity of 20,000 g.p.m. at 40-ft. head. These figures are given so that you might visualize the size of the Deculator installation.

The installation of the Deculator under description was completed and placed in operation March 27, 1952. Start-up was made without difficulty, but for the first several days of operation large bubbles of air were noted on the wire. Also, a small bleed-off line connected to the stock line entering the headbox showed entrained air. All flanged connections in the piping were checked for leaks and the entire Deculator and piping were given a coat of paint to help seal any small leaks. Further investigation, however, revealed that the air was entering the system through the sealing glands of the secondary fan pump. When these were properly sealed no more entrained air was noted.

The operation of a machine with the Deculator installation does not complicate paper machine operation. On start-up some additional time, about 5 min., is required to fill the main vessel, and four additional motors must be started. After the system has been started and filled with stock and water, the level in the Deculator is automatically controlled by two Paul valves. Machine operation from this point on is normal. Changes in basis weight and machine speed are made without making any changes in the valve settings of the Deculator. Figure 1, the Deculator flow system, shows the flow of stock, water, and air through the Deculator system.

RESULTS

In the evaluation of a piece of equipment such as the Deculator, it is very difficult at times to say that an improvement or an impairment is directly chargeable to the equipment in question. So many other variables can affect the pulp and paper process, that only pronounced changes will be discussed. Also, the results we have obtained may not hold true for other kraft paper installations because, as most papermakers know, two apparently identical machines making the same grade from the same furnish will rarely perform in exactly the same manner.

Wire pit foam and headbox foam have never been a problem for us except when certain types of additives, such as urea formaldehyde, wet-strength resins, or starch materials have been used. When these materials were used, foam on the wire pit surface was quite noticeable. However, since the Deculator installation, this foam has been definitely reduced and in some cases entirely prevented. On paper machines where foam is a day-to-day problem it is definitely believed that deaeration of the stock has eliminated the trouble.

One definitely noticeable, result of the Deculator installation was an increase in over-all efficiency, due to a reduction in wet-end breaks, and a reduction in drier and dry-end breaks. This evaluation was made over two 6-month periods, April to September, inclusive, for 1951 and 1952. These periods were chosen rather than the 6-month periods immediately before and after the Deculator was installed, in order that seasonal changes would not enter in as a variable. It is well known in the kraft industry that there is a seasonal variation in wood that affects pulp quality and, in the final analysis, machine operation and paper quality.

Shown in Fig. 2 is lost time due to wet-end breaks for the two 6-month periods of 1951 and 1952, before and after installation, which was completed March 27, 1952.

For drier and dry-end breaks the same two periods were chosen, and this relationship is shown in Fig. 3. Note that in both Figs. 2 and 3 the 1952 lost time, after installation of the Deculator, is lower than during the 1951 period. Average monthly savings in machine down time for wet-end breaks mounted to 3 hr. 4 min., and for drier and dry-end breaks 5 hr. and 54 min. per month. Note also that the lost time curve for 1952

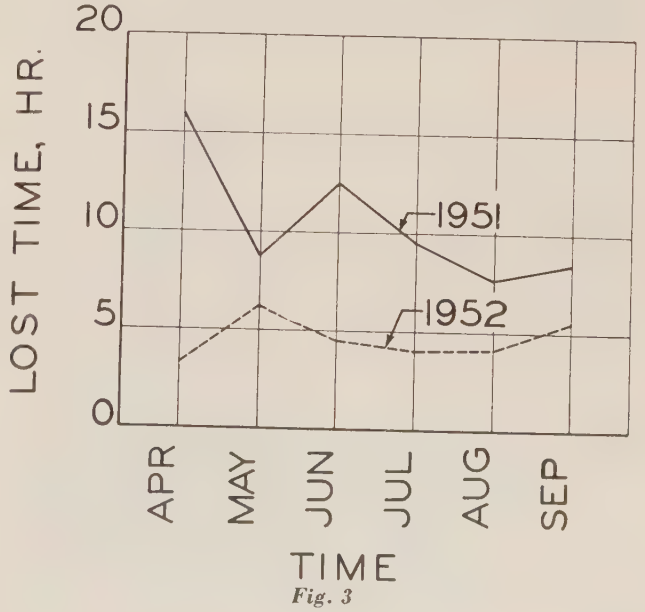

Fig. 3

is flatter because the magnitude of variation from month to month is smaller.

Another analysis of increased efficiency was gotten by considering over-all machine efficiency. Over-all machine efficiency is defined as actual production divided by theoretical production, multiplied by 100. Using the same two 6-month periods mentioned above there has been an average monthly increase in over-all efficiency of 2.97% (Fig. 4). In this analysis we have again selected the same monthly period in each year in order to eliminate seasonal variables. It was also noted in this analysis not only that the efficiency is higher but also that the magnitude of variation is much less than it was before the Deculator was installed.

As mentioned earlier, one of the basic problems experienced on our machine was a stock surge on the wire which caused a variation in basis weight in the machine direction. This variation has been verified innumerable times for the past 6 years by cutting a 6-in. roll of paper and then, after conditioning, weighing each foot of this 6-in. machine-direction strip for 1000 ft. These weight figures were then plotted, and the nature of the weight variation or surge could be studied. By this method it was found that the magnitude of weight variation was 10% which is the maximum allowable variation. However, after the Deculator installation was made, checks on weight variation, as described above, showed that the maximum variations had been reduced to 7%.

The evaluation of changes in the formation of a sheet of paper is at times quite difficult. This feature of a sheet of paper can only be determined by visual inspection and by comparing specific sheets with other papers from the machine. There are many qualities of the stock as well as the method of handling the sheet on the machine that affect formation. In addition to mechanical features of a machine, lumps or flocs of fiber adversely affect formation. It is the reduction of these fiber-flocs by the Deculator that has most noticeably improved formation.

A reduction in fiber-flocs was also noticeable in the headbox itself. Before installation of the Deculator, fiber bundles and stringers were found in the headbox and perforated rolls whenever the headbox was opened for cleaning. Although these stock hang-ups have not

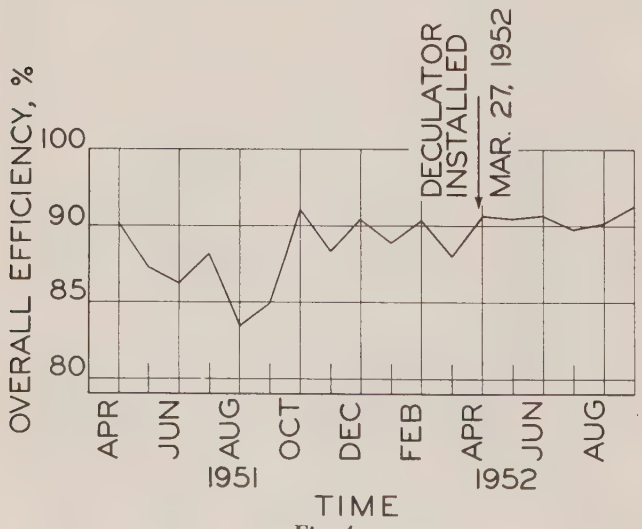

Fig. 4

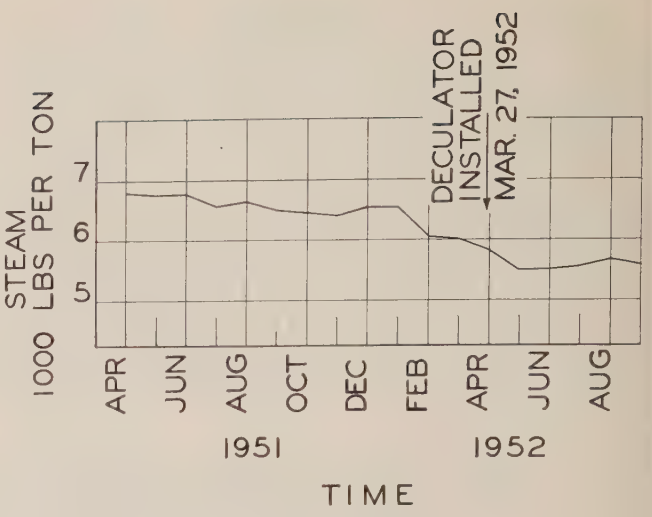

Fig. 5

been completely eliminated, they have been reduced to a great degree by deaerating the stock to the headbox.

Smoothness tests made on the same grade of paper produced before and immediately after the Deculator installation showed an improvement in smoothness as determined by the Gurley smoothness tester. Smoothness tests for the top side of the sheet were 35 and 34 sec. and for the bottom 20 and 25, indicating a greater improvement in smoothness on the bottom or wire side than on the top. The increased smoothness probably indicates a better-filled surface due to the absence of foam when the sheet was formed on the wire, and also reflects the fact that the machine tender is able to use more water in the sheet.

A check on records of steam consumed for drying all grades of paper show that, since the Deculator installation, steam consumption has dropped 17%. These figures are shown graphically in Fig. 5. This reduction in steam required for drying is probably due to the fact that a sheet made from air-free stock, having improved formation and smoothness, has better contact with the drier.

Other than the physical properties of the sheet mentioned above, no change was noticed in caliper, bursting strength, tear, tensile, or fold. The production of high density sheets is easier, however.

There have been no breakdowns of the Deculator since its installation and very few, if any, adjustments are necessary once it is set for a particular paper machine. Maintenance costs have been well under that normally expected of equipment of this type.

CONCLUSIONS

The deaeration of stock for a kraft paper machine by means of the Deculator has proved to be a definite aid to paper machine operation. Increased production was obtained by decreasing down time due to breaks. Foaming problems have been eliminated on the wet end and certain improvements in paper quality have been realized. Formation and smoothness of the sheet were improved and weight variations reduced. Although no appreciable increase in sheet density was noted, the production of sheets requiring high density is much easier.

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Density, Viscosity, Specific Heat, Thermal Conductivity, and Prandtl Number Versus Concentration and Temperature

Sulphite Waste Liquor, III

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Sulphite waste liquor density, viscosity, specific heat, and thermal conductivity values have been collected from the literature or determined experimentally at various temperatures and concentrations of dissolved solids. "Best" average values of these properties and of Prandtl numbers are proposed and are recommended for use in engineering design calculations. Examples are given showing applications of the data to design of fluid flow and heat transfer equipment.

SULPHITE waste liquor processing almost always requires transportation of the liquor through pipes and often requires the heating or cooling of the liquor in surface heat exchangers. Thus the size and cost of fluid flow and heat exchange equipment must be carefully considered as part of any contemplated sulphite waste liquor processing system whether the system is based on use of the magnesium, ammonium, or sodium cation, or on the usual calcium cation. A limited number of investigations relating to these subjects has been published (*1–4*).

The procedures for design of fluid flow and heat exchange equipment have now been fairly well worked out. Prediction of the size necessary to achieve a particular specified performance is accomplished by consideration of the several variables involved. These variables may be parameters expressing such thermodynamic or transport properties of fluids as density, specific heat, viscosity, and thermal conductivity, or else expressing geometric properties of the equipment such as diameter of the pipe and area of the surface, or potential fields such as velocity or temperature gradients. To simplify the treatment of these complex problems which often involve many variables, it has been found convenient to use the principles of dimensional analysis (*5*) and combine some variables together into certain groups of variables which are dimensionless, and thus are called dimensionless groups or dimensionless numbers. Some important dimensionless numbers are the Reynolds number = $N_{Re} = DV\rho/\mu$, the Fanning friction factor = $f = DFg_c/2LV^2$, the Prandtl number = $N_{Pr} = C\rho\mu/k$, and the Nusselt number = $N_{Nu} = hD/k$, and the significance of these symbols is given below. Design is accomplished primarily by use of experimentally found relationships among these and other dimensionless groups of variables.

However to design in this way, one needs to know numerical values for several properties of sulphite waste liquor at the condition of temperature and total solids concentration of interest. Thus the present work has been carried out to bring together values of sulphite waste liquor density, viscosity, specific heat, and thermal conductivity from various published sources and from newly conducted experiments, and to recommend what appear to be "best" values for these properties and for the Prandtl number.

Of course the several properties will vary somewhat for individual sulphite waste liquors depending upon conditions of their production such as species of wood and nature of the cation employed, types of pulp manufactured, and whether or not such operations as steam stripping, evaporation, and fermentation or yeast growth are carried out. However, the differences in liquor characteristics arising from these causes are usually sufficiently small so that the now-recommended properties are of adequate precision for use in engineering design calculations for sulphite waste liquor processing equipment.

DENSITY

All available sulphite waste liquor densities have been collected, recalculated to English units, and compared. Most of these values (*6–11*) have been plotted in Fig. 1 versus temperature with weight per cent total solids (i.e., pounds total solids per 100 lb. of solution) shown as a parameter. The density data not plotted (*2, 12–17*) either consisted of only a few scattered points, or

Table of Symbols

A	= area, ft.
D	= diameter, ft.
F	= friction head, ft.-lb. force per lb. mass of fluid
V	= linear velocity, ft. per sec.
M	= per cent solids concentration, lb. solids/100 lb. solution
C_p	= heat capacity, B.t.u. per lb. °F.
g_c	= conversion factor = 32.174, lb. mass, ft./lb. force, sec.^{2}
h	= coefficient of heat transfer, B.t.u. per (hr.) (sq. ft.) (°F.)
k	= thermal conductivity, B.t.u. per (hr.) (sq. ft.) (°F. per ft.)
w	= mass rate of flow, lb. per hr.
t	= temperature difference, °F.
x	= linear distance, ft.
ρ	= density, lb. mass per cu. ft.
μ	= viscosity, lb. mass/ft. sec. or 0.01 g./sec. cm.
μ_w	= viscosity at wall temperature
f	= $DFg_c/2LV^2$ friction factor, dimensionless
N_{Nu}	= hD/k Nusselt number, dimensionless
N_{Pr}	= $C\rho\mu/k$ Prandtl number, dimensionless
N_{Re}	= $DV\rho/\mu$ Reynolds number, dimensionless
N_μ	= $\mu/\mu w$ viscosity ratio, dimensionless
f	= $DFg_c/2LV^2$ friction factor, dimensionless

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else related to liquors at conditions which were incompletely specified, or had been considered in another publication. The data used to prepare TAPPI Data Sheet 28 and CPPA Data Sheet C-3 are apparently those of Moore (*8*).

The differences apparent among the values given by the several authors may be caused by variations in analytical method for total solids concentration or in the nature or composition of the total solutes of the liquors. However, data reported from the United States (*8*), Germany (*10*), and the U.S.S.R. (*9*) are in fairly good agreement in spite of differences in wood sources and pulping methods. Noll (*10*) examined liquors from six different German plants and could not find major differences between fermented and unfermented pine liquors, or between beech liquors before and after yeast production. The density of beech liquors is reported to be a little higher than pine liquor at the same total solids concentration. In some experiments conducted in this laboratory, it has been found that the density of magnesium or ammonium sulphite waste liquor is about the same as that of calcium liquor at the same total solids concentration (when determined by evaporation of a known weight of liquor to dryness and then heating for 24 hr. at 60°C. under 15 mm. Hg absolute pressure).

The several pieces of density data were considered and then estimates were made of the "best" values of density for an "average" sulphite waste liquor at various temperatures and total solids concentration. These best values are shown in Fig. 1 as solid lines at intervals of 10% total solids concentration. The values defined by and between these lines are recommended for use in engineering design calculations, but not in analytical applications for which there is required higher precision data for the individual sulphite waste liquor of interest.

VISCOSITY

A considerable number of sulphite waste liquor viscosity values are published and these have been collected, and in most cases plotted in Fig. 2 versus temperature at various concentrations as follows: unfermented liquor from western hemlock (*7*), unspecified liquors probably from spruce (*8*) and perhaps from gymnosperms (*17*), fermented liquor from pine (*18*), unfermented liquor from beech (*18*), and water (*19*). The viscosity data of Moore (*8*) have been given as TAPPI Data Sheet 29 and CPPA Data Sheet C-4, and the results of Kobe and McCormack (*7*) have appeared as TAPPI Data Sheet 156. Recommended values for viscosity of sulphite waste liquor at various temperatures and total solids concentrations are shown by solid lines in Fig. 2 and these lines have been drawn after considering the above-mentioned data as well as some other reported data (*6*, *14*) which are not included on Fig. 2.

Variation in values reported for viscosity of sulphite waste liquors at a particular state of temperature and total solids concentration may be attributed to differences in viscosity determination procedures or in liquor types or treatments. Most reported viscosity data were secured by use of an Ostwald-type capillary viscometer assuming Newtonian behavior. However, some of the present authors have recently conducted experiments at several velocity gradients using a Brookfield viscometer and the results indicate that Newtonian behavior persists up to about 40 or 45% total solids concentration at about 70°F. as may be discussed in a

Table I. Significance of Symbols[a]

Symbols	Ref. no.	Symbols	Ref. no.	Symbols	Ref. no.	Symbols	Ref. no.
	6		10		17		21
	7		10		18		21
	8		11		18		
	9		19		20		

[a] Numbers inside symbol circles in figures give weight percentages of solids in sulphite waste liquors.

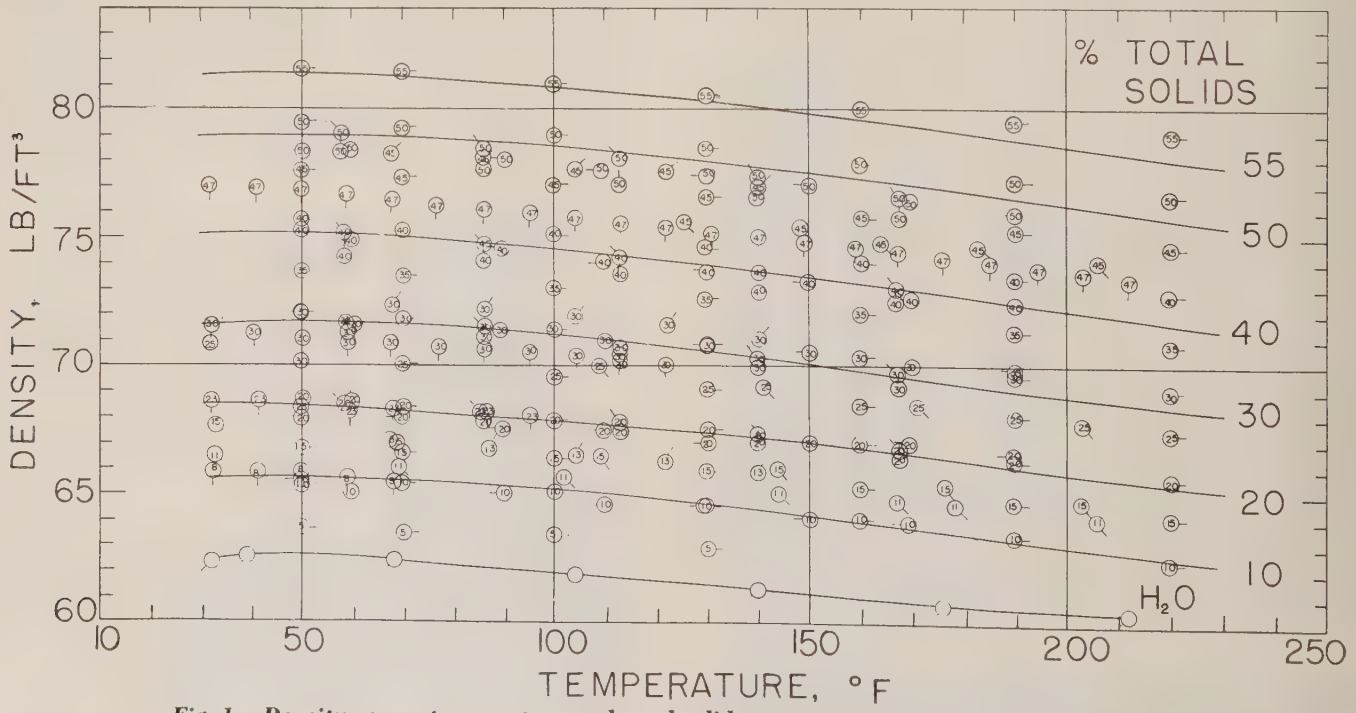

Fig. 1. Density versus temperature and total solids concentration of sulphite waste liquor

later paper. This rheological behavior of a sulphite waste liquor is certainly influenced by the degree of change in its characteristics which may be brought about by strong heating (*18*) and this change may be particularly marked with respect to increase in viscosity resulting from the heating of ammonium sulphite waste liquors (*11*). These influences are probably not of importance with respect to the data given in Fig. 2 since these data appear to have been obtained on sulphite waste liquors secured in routine industrial operation without special treatments other than those indicated.

SPECIFIC HEAT

The sulphite waste liquor specific heats reported by McCleave and Kobe (*20*) seem to be the only values published. The individual experimental points are given in Fig. 3. The original authors have summarized their results by equation (1):

$$C_p = 0.97 - 0.004M \qquad (1)$$

Consideration of specific heats reported for aqueous solutions of various electrolytes and nonelectrolytes shows that the temperature dependence is not large within the range of present interest. Thus the values recommended for specific heat are given as solid lines which have been drawn in Fig. 3 assuming that temperature dependence is negligible.

THERMAL CONDUCTIVITY

Since no values of the thermal conductivity of sulphite waste liquor appear to have been published, an apparatus and a procedure were worked out and a few measurements were made (*21*).

A compartment was used for retaining the sample liquid as an agar gel situated between a second compartment through which hot water flowed, and a third compartment through which colder water flowed. Each water compartment was a stainless steel tank 0.50 in. thick and 6 in. square. Water streams flowed in and out through 0.25-in. diameter metal tubes into which thermowells were soldered. The tubes were joined to the edge of the water compartments, and water was circulated inside the compartments by baffles soldered to the back surfaces. The surface of each water compartment facing the sample gel was a $7\frac{1}{2}$ by 8 by $\frac{1}{2}$-in. copper plate. Two thermowells, 0.125 in. in diameter and 3.5 in. deep and 2.25 in. apart, were located at the top of each copper plate to permit measurement of the temperature difference across the gel. The gel compartment was formed between the two copper plates which were separated by a Neoprene gasket ring 0.25 in. thick with inner dimensions of 6 by 6 in. and outer dimensions of 10 by 10 in. Inserted into the gasket between the plates were nine Lucite "spacers," 0.125 by 0.125 by 0.25 in. to insure a gel thickness of 0.250 ± 0.002 in. Two small sections of the Neoprene gasket were cut away at the top in order to permit the sample to be poured into the gel compartment. Four T bars were used to clamp the two parts of the apparatus together. Temperature differences were measured by use of copper constantan thermocouples with junctions situated inside fine glass tubing. Thermocouple voltages were measured with a Leeds and Northrup Model 8662 Precision Potentiometer. The whole apparatus was insulated heavily, and water was fed by gravity from two 250-gal. tanks to the apparatus to secure constant water input temperatures and flow rates, and to avoid air entrainment.

For thermal conductivity measurement, a 300-gram sample of a sulphite waste liquor was heated to boiling and then powdered "Difco Bacto-Ager" (Difco Laboratories, Detroit, Mich.) was added in sufficient amount to provide the desired agar concentration. Heating with agitation was continued until the agar was completely dissolved and this solution was poured into the gel compartment and cooled by circulating the cold

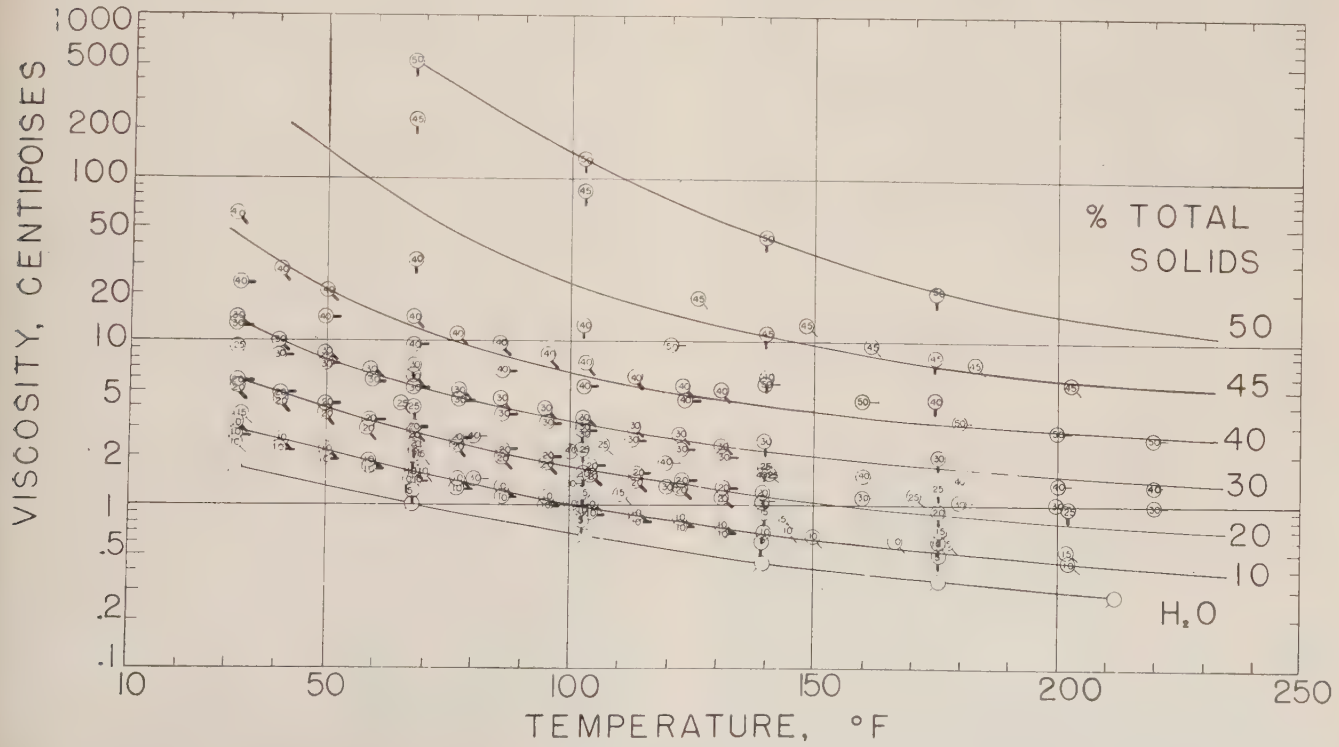

Fig. 2. Viscosity versus temperature and total solids concentration of sulphite waste liquor

water at about 22°C. and 150 to 200 grams per min. After the gel had set, hot water was flowed into the compartment at about 43°C. and 150 to 200 grams per min. The thermocouples were then inserted into the copper plates and the apparatus shaken to remove any trapped air bubbles in the water compartments. Readings were taken at 10-min. intervals until constant temperature differences and good heat balances were attained using water flow rates measured by direct weighing.

Specific application of the procedure to a fermented calcium sulphite waste liquor at 47.9% total solids concentration and containing 1.0% agar is exemplified by the following data and calculations: temperature changes in hot and cold water streams = ΔT = 3.73 and 2.73°F.; temperature difference across sample section = Δt = 18.5°F.; flow rates for hot and cold water streams = w = 19.5 and 25.8 lb. per hr.; specific heat of water = C_p = 1 B.t.u. per lb. per °F.; so heat transferred = $q = wC_p\Delta t$ = 72.8 and 71.7 B.t.u. per hr. for hot and cold streams, or 71.7 B.t.u. per hr. as the average. Thus if sample thickness = X = 0.0208 ft., and area = A = 0.263 sq. ft., then thermal conductivity including 1% agar = k' = 0.307 B.t.u. per (hr.)(sq. ft.)(°F. per ft.).

The agar effect was mostly removed by determining k' at various agar concentrations, then extrapolating linearly to zero agar concentration to obtain the sulphite waste liquor thermal conductivity = k = 0.302. The method was tested by carrying it out at about 90°F. on water, and on an equal volume mixture of water and glycerine, to give the thermal conductivity values of 0.38 and 0.26, compared with reported values of 0.36 (*19*) and 0.24 (*22*) B.t.u. per (hr.) (sq. ft.)(°F. per ft.), respectively.

This gel method was used to measure the thermal conductivity of two sulphite waste liquors: an unfermented magnesium sulphite waste liquor, or "red liquor" (*23*) received at 64.5 weight per cent solids and kindly provided by Harold Bialkowsky, Weyerhaeuser Timber Co., Longview, Wash., and also a steam stripped and fermented calcium sulphite waste liquor (*24*) received at 45.5 weight per cent solids and kindly provided by E. O. Ericsson, Puget Sound Pulp and Timber Co., Bellingham, Wash. The following experimental results were obtained at about 90°F. for the thermal conductivities of these liquors: unfermented magnesium sulphite waste liquor, 0.35, 0.34, and 0.33 for 18.3,

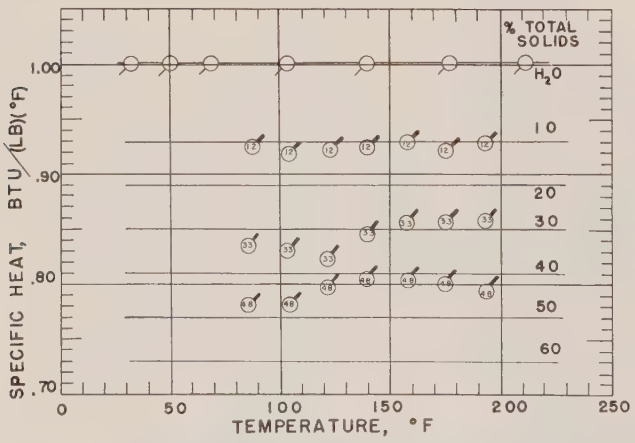

Fig. 3. Specific heat versus temperature and total solids concentration of sulphite waste liquor

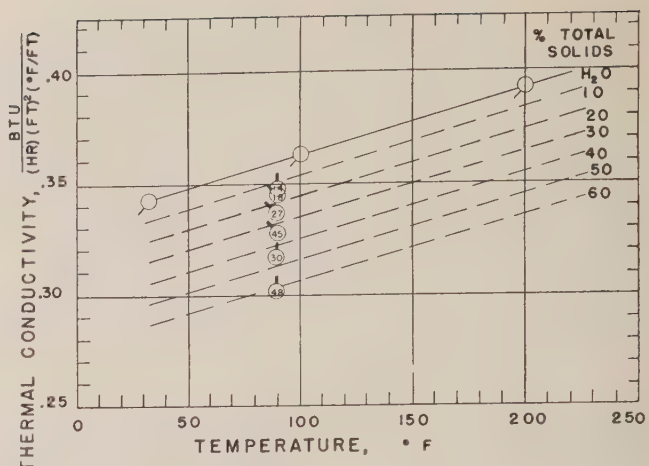

Fig. 4. Thermal conductivity versus temperature and total solids concentration of sulphite waste liquor

27.6, and 45.3% solids, respectively; fermented calcium sulphite waste liquor, 0.35, 0.32, and 0.30 for 13.8, 29.6, and 47.9% solids, respectively. Although these data are of only modest precision, it is seen that the thermal conductivity of sulphite waste liquors does not change much with total solids concentration whether or not the liquor has been fermented.

To represent these results in a general way, the thermal conductivity of water (*19*) has been plotted against temperature in Fig. 4 together with the conductivities now found for sulphite waste liquors at 90°F. and various total solids concentrations. Liquor conductivity at various temperatures is estimated to be approximately as represented by the dotted lines drawn parallel to the line for water in view of data available in the literature (*25*).

PRANDTL NUMBERS

Coefficients for heat transfer in a fluid are often correlated partly in terms of the specific heat, viscosity, and thermal conductivity of the fluid brought together in a dimensionless group called the Prandtl number = $N_{Pr} = Cp\mu/k$. The three quantities involved in the Prandtl number are properties which become fixed when the state of concentration and temperature of a sulphite waste liquor is fixed. Thus the Prandtl number will have a particular value characteristic of a liquor at a particular concentration and temperature. Since recommended values for liquor properties are available from data submitted above, the Prandtl numbers have been calculated from these properties and are represented in Fig. 5 where they are directly related to sulphite waste liquor concentrations and temperatures.

APPLICATION OF DATA

It is emphasized that the above recommended properties are not usually suitable for application to analytical problems because the data are mostly of limited accuracy, and because sulphite waste liquors vary in properties depending upon their source and the treatments which they have undergone.

The present data are principally useful to aid in the engineering design of fluid flow and heat transfer systems for handling sulphite waste liquors as illustrated by the following two example problems.

What is the pressure drop which occurs when 10,000 lb. per hr. of sulphite waste liquor at 30% total solids

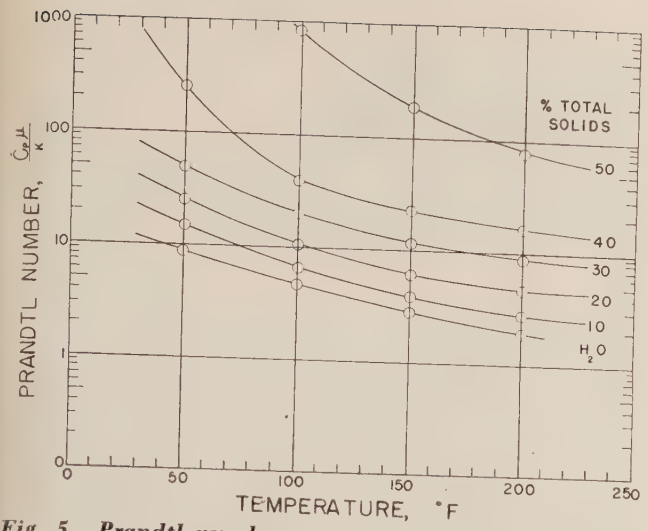

Fig. 5. Prandtl number versus temperature and total solids concentration of sulphite waste liquor

at 150°F. flows through a horizontal stainless steel pipe of 1 in. inside diameter and 100 ft. long.

For this liquor $\rho = 70$ lb. per cu. ft. from Fig. 1 and $\mu = 2.0$ cp. $= 0.0013$ lb. mass per (ft.) (sec.) from Fig. 2. Also $D = 0.083$ ft. so $A = 0.0055$ sq. ft. and $V = (10{,}000)/(3600)(70)(0.0055) = 7.3$ ft. per sec. Thus $N_{Re} = DV\rho/\mu = (0.083)(7.3)(70)/(0.0013) = 32{,}000$. In Perry's Handbook (Fig. 23, p. 382 (*19*)), we find for commercial steel pipes that this Reynolds number corresponds to a Fanning friction factor $= f = 0.0066$. The rate of energy conversion by friction per pound mass of fluid flowing, F, can be estimated by use of the Fanning equation (equation (14), p. 377 (*19*)) as:

$$F = \frac{4fLV^2}{2g_cD} = \frac{(4)(0.0066)(100)(7.3)^2}{(2)(32.2)(0.083)} = 26.3 \frac{\text{ft.-lb. force}}{\text{lb. mass}}$$

The desired pressure drop is now calculated by introducing F into an approximately integrated form of the Bernoulli equation (equation (12), p. 377 (*19*)), as:

$$\Delta P = p_1 - p_2 = \frac{F}{V} = F\rho = \frac{(26.3)(70)}{144} = 12.7 \text{ lb. force per sq. in.}$$

What is the length of 1-in. inside diameter stainless steel pipe which is required for heating 10,000 lb. per hr. of sulphite waste liquor at 30% total solids from 150 to 200°F. if the liquor is flowing inside the pipe with heat supplied by steam condensing at 212°F. on the outside wall of the pipe, and if the resistance to heat transfer in the sulphite waste liquor film is assumed to be the total resistance to heat transfer?

The approximate average temperature of the liquor inside the exchanger $= 150 - 200/2 = 175$°F. and evaluation of liquor properties at this temperature and 30% solids gives: $\rho = 69.5$ from Fig. 1, $\mu = 1.8$ cp. $= 0.0012$ lb. mass per (ft.) (sec.) from Fig. 2, so $V = 7.3$ ft. per sec. and $N_{Re} = 35{,}000$. Also from Fig. 2, we can evaluate a viscosity group as $N\mu = \mu/\mu_w = 1.8/1.5 = 1.2$, and from Fig. 5, there is obtained the Prandtl number $= N_{Pr} = 10$. These quantities can be used, for example, in the Seider and Tate equation (equation (6.2), p. 103 (*26*)) to calculate the Nusselt number $= N_{Nu} = 0.027 (N\mu)^{0.14} (N_{Re})^{0.80} (N_{Pr})^{0.33} = 250$. Since $N_{Nu} = (hD/k)$, and since $k = 0.36$ from Fig. 4, then $h = k(N_{Nu})/D = (0.36)(250)/0.083 = 1080$ B.t.u. per (hr.)(sq. ft.)(°F.).

Now to evaluate the over-all transfer coefficient, U, as an average value applicable over the period of time designed for fouling, the resistances to heat transfer arising in the average scale and dirt films as well as the condensing steam film, the metal pipe wall, and the above obtained sulphite waste liquor heat transfer coefficient must all be considered in the calculation (for example, see equation (22), p. 465 (*19*) and equation (6.6), p. 106 (*25*)). However, to retain simplicity we shall not try to deal with scale in the present problem and shall merely assume that $U = h = 1080$ B.t.u. per (hr.)(sq. ft.)(°F).

Since from Fig. 3 one can obtain $Cp = 0.85$ B.t.u. per (lb.)(°F)., the heat duty can be estimated as: $q = wCp(t_2 - t_1) = (10{,}000)(0.85)(200 - 150) = 425{,}000$ B.t.u. per hr.

The temperature differences at the ends of the exchanger are: $\Delta T_1 = 212 - 150 = 62$°F., and $\Delta T_2 = 212 - 200 = 12$°F. These are combined to give a logarithmic mean average temperature difference $\Delta T_{lm} = 30.5$°F. which is used in the flow equation (for example, equation (21), p. 464 (*19*)) to compute the necessary surface area of the heat exchanger as: $A = q/(U)(\Delta T_{lm}) = (425{,}000)/(1080)(30.5) = 12.9$ sq. ft. Geometric considerations now establish the required length of pipe to be: $L = A/(\pi D) = 12.9/(\pi)(0.083) = 50$ ft.

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Dye Adsorption on Wood Pulp

III. Effect of Pulp Processing on Specific Adsorption

E. F. THODE, A. J. CHASE, S. S. MAJMUDAR, and D. R. MacKINNON

Further experiments on the adsorption of the direct dye Benzo Fast Scarlet 4BSA (C.I. 327) from dilute solution have been made with bleached sulphite and alkaline pulps as adsorbents. Beater tests on four pulp samples representing different wood species and different types of cooks have been compared with results of dye adsorption tests. The results demonstrate that for any given chemical pulp the various physical properties measured during a beater test vary linearly with the logarithm of specific adsorption. This appears to hold for alkaline pulps despite the fact that the isotherms characteristic of sulphite pulps are not obtained upon adsorption on alkaline pulps. It is thought that this difference in isotherm characteristics may be related to the base-exchange capacity of the alkaline pulps. It appears that specific adsorption is not a unique criterion of strength properties of pulp when comparing pulp samples of different wood species or from different cooking processes. It is concluded as a result of controlled bleaching experiments that changes in dye adsorption parallel changes in the physical properties of sulphite pulp during the normal course of bleaching. Dye adsorption experiments cannot be run on peroxide bleached pulps by the present technique. Indications are, from preliminary observations, that changes in physical properties of pulp induced by drying are paralleled by similar changes in dye adsorption. A connection of the decrease in dye adsorption on drying with the hypothetical "irreversible cornification" phenomenon of pulp fibers is suggested.

IN RECENT papers, results have been reported of dye adsorption studies on bleached sulphite pulp. These results indicate that specific adsorption of the dyestuff Benzo Fast Scarlet 4BSA (milligrams of dye adsorbed by 1 gram of pulp fiber) is directly related to the physical properties of pulp handsheets (*1, 9*).

Since these relations were drawn from observations made during the course of mechanical treatment only, it became a matter of interest to determine what effect the chemical treatments of pulping and bleaching had on the dye adsorption phenomenon.

PROCEDURE

Dye Adsorption Technique

The dye adsorption procedure as previously reported by some of these authors (*9*) was slightly modified for the experiments described herein. The number of washings was reduced from six to four, since it was discovered that no appreciable change in the conductivity or specific dye adsorption of a pulp slurry was realized by the larger number of washings. The mass of material present previous to addition of the dye was determined by weighing on a triple-beam balance and adjusted by addition of water. This modification is thought to have improved the accuracy with which the initial dye concentration is determined.

Spectrophotometric Determination of Dye Concentration

In the experiments here reported a Beckman Model DU quartz prism spectrophotometer was employed for determining the final concentration of dye solution. The wave length of maximum light adsorption of the Benzo Fast Scarlet solution (5060 A) was used in all tests. It was determined that, below a concentration of 0.04 gram per liter, solutions of Benzo Fast Scarlet follow the Beer-Lambert law. In other words, optical density

Table I. Outline of Pulping and Bleaching Operations

	Sulphite (ammonia base)	*Kraft*
Liquor strength, %	7.56 total SO_2	Active alkali 20
	1.45 comb. SO_2	Sulphidity 24.2
Maximum temperature, °F.	285	335
Maximum pressure, p.s.i.g.	90	98
Penetration time, hr.	3	$1^1/_2$
Time at pressure, hr.	4	$2^1/_2$
Total time, hr.	$7^1/_2$	4
Permanganate nos.		
Softwood	11.2	32.5
Poplar	6.3	12.4
First-stage bleach		
Agent	Chlorine	Chlorine
Per cent of Cl_2 demand	60	35
Temperature, °F.	78	75
pH	2	2
Consistency, %	4	4
Time, hr.	1	1
Second stage		
Agent	Caustic	Caustic
Temperature, °F.	100	95
pH	10	10
Consistency, %	5	5
Time, hr.	$^1/_2$	$^1/_2$
Third stage		
Agent	NaOCl	Chlorine
Per cent of Cl_2 demand	40	35
Temperature, °F.	95	75
pH	9	2
Consistency, %	6	4
Time, hr.	3	1
Fourth stage	None	Same as 2nd stage
Fifth stage		
Agent	None	NaOCl
Per cent of Cl_2 demand		20
Temperature, °F.		95
pH		8.5
Consistency, %		11
Time, hr.		2
Sixth stage		
Agent	None	Chlorine
Per cent of Cl_2 demand		10
Temperature, °F.		75
pH		2
Consistency, %		5
Time, min.		15
Antichlor		
Agent	H_2SO_3	H_2SO_3
pH	1.5	1.5
Time, min.	15	15

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as determined spectrophotometrically is a linear function of concentration. The deviations from this relationship noted in the first paper in this series (*1*) were undoubtedly caused by the relatively wide band width employed by the instrument used for the earlier investigation. Close watch must be kept on the samples tested however; minute impurities in the pulp have also been observed to cause deviations on the part of the dye solutions.

Pulping Procedure

Two special cooks (one ammonia-base sulphite and one kraft) were made for this investigation in a compartmented laboratory digester. In each case one compartment was filled with poplar chips, the other with mixed softwood, predominantly spruce and hemlock. The resulting pulps were washed and screened separately and the two pulps from the same cook were each given similar bleaching treatments, differing only in the amount of bleach, as determined by their respective permanganate numbers.

An outline of the essentials of the cooking and bleaching operations is given in Table I. In every case the pulp was thoroughly washed with fresh water after each stage of bleaching.

Beater evaluation of the bleached pulps was carried out according to TAPPI Standards T 200 m-45, T 205 m-47, and T 220 m-47 (*8*). Method T 200 was modified to the extent of withdrawing from the beater larger samples of stock than specified, after each time interval, in order to provide pulp for dye adsorption tests.

Bleaching Experiments

For the purposes of studying the effect of bleaching on dye adsorption, a sample of commercial sulphite pulp in wet lap form was obtained and subjected to a variety of bleaching procedures. A portion of the pulp was bleached with chlorine water in an amount equal to 60% of the chlorine demand of the stock as determined by TAPPI Standard T 214 m-42 (*8*). This stock was thoroughly washed, and a portion set aside for testing.

This material was designated as "first stage" stock.

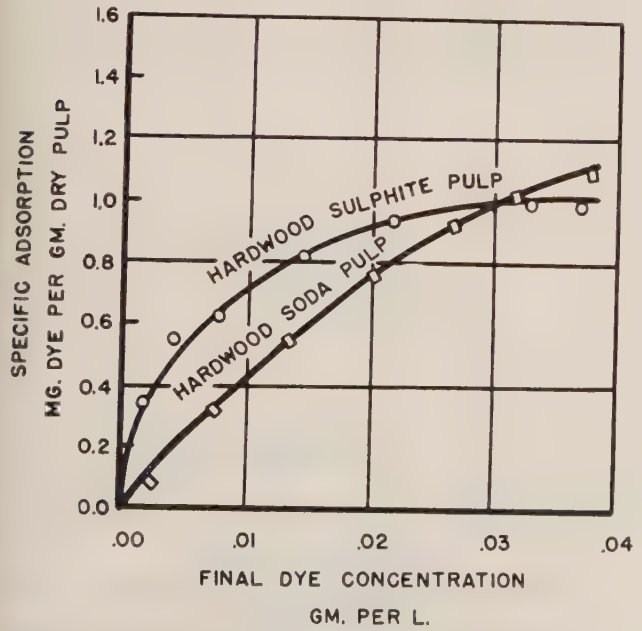

*Fig. 1. Adsorption isotherms, hardwood soda and hardwood sulphite pulps**

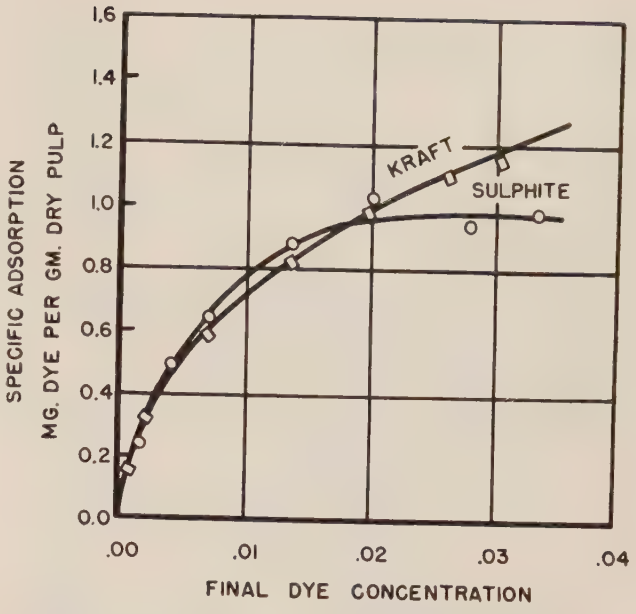

*Fig. 2. Adsorption isotherms, softwood kraft and softwood sulphite pulps**

The balance of this partially bleached pulp was then divided into three portions which were given the following treatments: (1) bleaching with sodium hypochlorite equivalent to 40% of the chlorine demand, consistency 9.6%, temperature 70°F., pH 8.2, for a period of 2.1 hr.; (2) bleaching with sodium hypochlorite equivalent to 25% of the chlorine demand, followed by washing and then bleaching with chlorine dioxide equivalent to 15% of the chlorine demand; (3) a hypochlorite bleach as in (2), followed by washing and then a treatment with 2.0% sodium peroxide based on weight of pulp. The chlorine dioxide bleach of (2) was carried out at 13.6% consistency, 85°F., pH 4.8 for a period of 5.75 hr., while the peroxide bleach of (3) required 3.15 hr. at 15% consistency, 100°F. and pH 11.4.

A sample of each material was then beaten for 30 min. in a ball mill (TAPPI method T 224 sm-45), samples were taken for dye adsorption tests, and handsheets made for physical tests.

Miscellaneous Tests

Dye adsorption tests were made on alkaline and acid pulps produced from about the same mixture of hardwoods, and also on softwood alkaline pulp. Adsorption isotherms were plotted from the data obtained.

RESULTS OF PULPING EXPERIMENTS

Comparison of Isotherms—Acid and Alkaline Pulps

As reported in the first paper in this series, unbeaten sulphite pulp from coniferous species of trees shows a Langmuir-type isotherm when dyed in the presence of KCl in a concentration of about 1.25×10^{-3} molar or less. The amount used for all experiments reported herein was exactly 1.0×10^{-3} molar. A Langmuir-type isotherm could therefore be expected.*

* *Authors' Note* (added in proof): Since the preparation of the manuscript for this paper, data have been obtained extending the adsorption isotherms for sulphite pulp above a final concentration of 0.04 gram per liter. These data indicate that sulphite pulps do not display, characteristically, isotherms with an absolutely horizontal portion, as may be inferred from the curves in Figs. 1 and 2. The straight-line portion of the curve for sulphite pulp has a pronounced, if small, slope of one division on the ordinate scale for every five on the abscissa. A difference in isotherm shape between sulphite and alkaline pulps is still noticeable. The new information is not believed to affect the validity of the interpretations set forth in this paper.

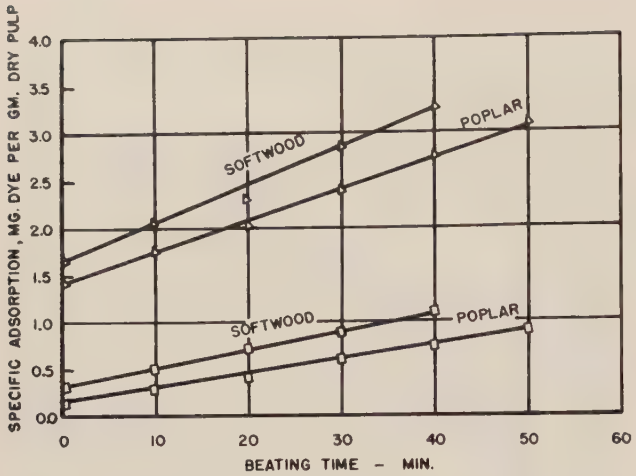

Fig. 3. Effect of time of beating on specific adsorption, sulphite pulps

Upper curves, runs with KCl present; lower curves, runs with no electrolyte added.

No alkaline pulp displayed a Langmuir-type isotherm with its typical level or nearly level portion. All alkaline pulps gave more or less parabolic isotherms, even when the concentration of potassium chloride was reduced. A comparison of results for soda and sulphite pulps prepared from approximately the same mixture of hardwood species is shown in Fig. 1. It may be seen that the flatter curve for the alkaline pulp intersects the curve for the sulphite pulp at a value of the abscissa of 0.03 gram per liter final dye concentration. Since this is the final dye concentration used wherever possible in beating experiments, one would expect little difference in dye adsorption comparisons between those two particular pulps. However, another aspect of the matter is demonstrated by the isotherms of Fig. 2, where commercial sulphite and kraft softwood pulps are contrasted. Here, the two isotherms are identical below 0.02 gram per liter but increasingly diverge above that point. It appears that the only essential point that can be generalized is that the alkaline pulps do not yield the same type isotherm as do sulphite pulps.

The reason for this phenomenon is not apparent from the information now at hand. A possible explanation is that alkaline pulps may have a greater amount of metallic ions more or less permanently bound to the cellulose than do acid pulps. The literature on the development of dielectric papers gives evidence to support this possibility. McLean and Wooten (*5, 6*) have reported on the ion-exchange capacities and ash contents of various rag and kraft insulating papers and have qualitatively concluded that high beta and gamma-cellulose contents are associated with high exchange capacities. High exchange capacity, in turn, is directly related to ash content, which implies the presence of closely bound metal ions. These authors also refer to previous work by Kullgren and DuReitz in which sulphite pulps were studied. In the case of sulphite pulps it is thought that sulphonic acid groups present on residual lignin may be responsible for ion exchange capacity.

In the absence of controlled experiments in comparison of the kraft and sulphite pulps, definite conclusions cannot be drawn. It is possible, however, that a bleached kraft pulp may retain more hemicelluloses and thus have a higher base-exchange capacity than a bleached sulphite. The ions adsorbed by these hemicelluloses might then be responsible for the differences in the dye adsorption behavior of the two different pulps.

Comparison of Beater Test Results—Acid and Alkaline Pulps

If it is assumed that the isotherm of an alkaline pulp has a reasonably small slope in the region of 0.03 gram per liter final dye concentration, it is still possible to assume that changes in dye adsorption during beating are a matter of actual changes in the amount of adsorbent surface. The pulps prepared in the laboratory cooks were therefore subjected to beater tests and plots of dye adsorption as a function of beating time made. Dye adsorption was determined both with and without potassium chloride present in the solution. The higher set of curves in Figs. 3, 4, and 5 are those for runs employing potassium chloride.

It may be noted from Fig. 3 that the softwood sulphite pulp displays a greater dye adsorption than the hardwood pulp at all stages of beating, as would be expected from the larger surface of softwood fibers. However, if the kraft pulps are compared (compare Figs. 4 and 5) it is found that the hardwood pulp evidently "hydrates" more rapidly and after 20 min. of beating has a greater dye adsorption than the softwood pulp.

Of primary importance, however, among the results shown in these three figures is the fact that a linear increase in dye adsorption with time of beating is found for both acid and alkaline pulps.

Figures 6 to 9 display the correlation between specific dye adsorption and the physical properties of bursting, tensile, and tearing strength of handsheets. It should be noted that the specific dye adsorption data in these figures represent what may be called the net adsorption induced by the presence of electrolyte. The data plotted were calculated by subtracting the value for specific adsorption in the absence of electrolyte from the value obtained by the usual procedure employing potassium chloride "assistant." If the effects are the same as those shown in Figs. 3 and 4 of the second paper in this series (*9*) physical properties should be linear with the logarithm of specific adsorption in either case.

It may be seen that all four pulps display the semilogarithmic relationship of specific dye adsorption to physical properties noted in the previous paper. An

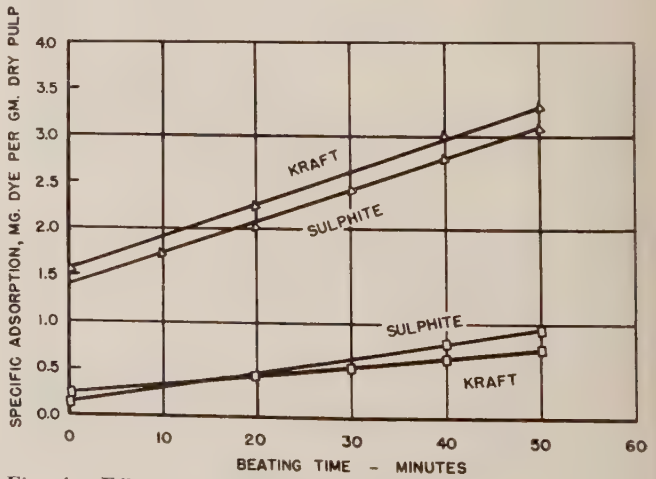

Fig. 4. Effect of time of beating on specific adsorption, hardwood pulps

Upper curves, runs with KCl present; lower curves, runs with no electrolyte added.

Table II. Specific Adsorption and Physical Properties of Stock in Various Stages of Bleaching[a]

	Unbleached	1st Stage (Cl_2) bleach	Final bleaches—Hypochlorite	Final bleaches—Chlorine dioxide	Final bleaches—Sodium peroxide
Specific dye adsorption, mg. dye/g. dry pulp	2.28	2.75	3.03	2.80	2.41[b]
Burst factor	27.5	34.9	42.8	43.4	38.4
Tensile strength, breaking length, m.	5100	6400	7600	7300	6700
Tear factor	84.5	58.7	59.2	71.2	65.0
C.S. freeness, ml.	580	570	515	525	505

[a] All stock beaten in a ball mill for 30 min.
[b] Figure doubtful, silicates interfered with measurement.

examination of these results leads to the conclusion that the correlation of specific dye adsorption with strength properties must be restricted to pulp from the same pulping process and of the same original wood species. In other words it is not sufficient merely to know the specific dye adsorption of a pulp in order to predict its physical properties. This conclusion is certainly to be expected if specific dye adsorption is thought to be connected with external specific surface. While external surface is considered to be an important factor in the strength of paper, it is not alleged to be a unique criterion of strength.

RESULTS AND DISCUSSION—BLEACHING EXPERIMENTS

The results of the bleaching experiments are summarized in Table II. The specific dye adsorption is the figure obtained by the standard procedure utilizing potassium chloride. Results for the one-stage (chlorine) bleach, the two-stage (hypochlorite) bleach, and the three-stage (chlorine dioxide) bleach are also presented in bar-graph form in Fig. 10 as per cent of properties of unbleached stock. Note that the latter two represent the same degree of purification, while the first represents a lesser amount of purification, being the first stage of the other two processes. It may be seen that, in general, dye adsorption parallels changes in physical properties in the various stages of bleaching.

It would appear that a deviation toward a too low value of specific dye adsorption occurs with the two-stage bleach, even more so with the three-stage bleach. In explanation, it should be borne in mind that each additional stage of bleaching involves additional protracted washing of the pulp, with consequent loss of fines. This loss of fines would presumably have less effect on strength properties than on dye adsorption.

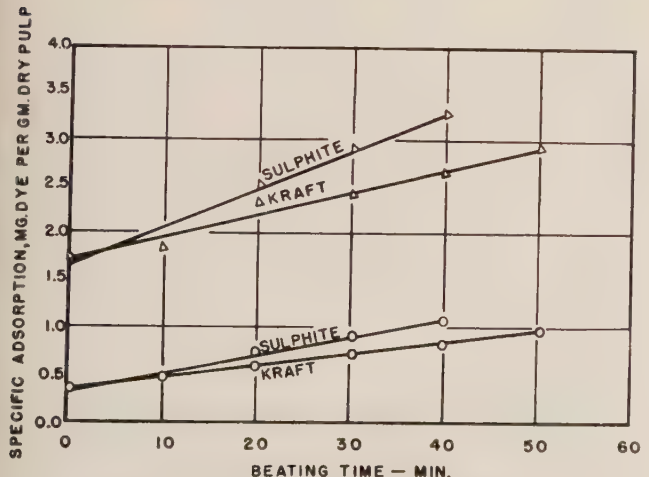

Fig. 5. Effect of time of beating on specific adsorption, softwood pulps

Upper curves, runs with KCl present; lower curves, runs with no electrolyte added.

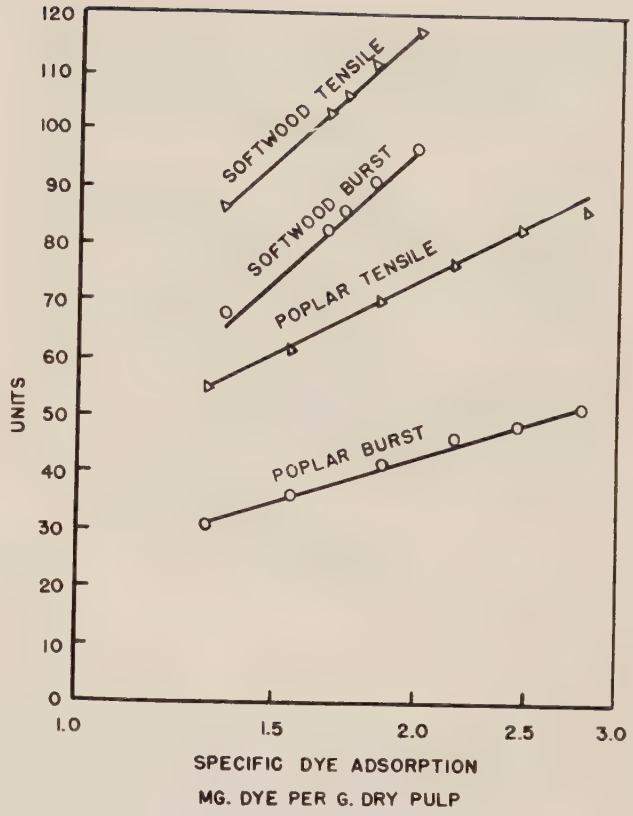

Fig. 6. Relation of physical properties to specific adsorption ("net"), kraft pulps (units: burst factor, breaking length in hectometers)

It may be seen that the adsorption data for the sodium peroxide bleached stock do not correlate well with the other figures. Great difficulty was experienced in obtaining any dye adsorption data at all with this stock because of an adverse effect on the dye solution of some impurity associated with the pulp. Such pulp, if added to dye solution, after the usual washing procedure, would cause flocculation of the dye. It was assumed that the material causing the difficulty was the residual silicate from the peroxide bleaching operation. Attempts were made to remove this material by means of prolonged and repeated extraction with mild alkali, followed by neutralization. Although the flocculation difficulty was overcome, the pulp still did not have the right "feel" and good reproducibility of results was not achieved.

It is concluded that if dye adsorption tests are to be made on a sulphite pulp, the degree of bleaching of the pulp will not affect the correlation of physical properties with specific adsorption. Adsorption experiments on peroxide bleached pulp are not recommended.

EFFECT OF DRYING

It is well known that the physical properties of handsheets made from dry lap that has been dispersed are different from those of handsheets made from slush stock. The tear is usually up, the burst and tensile

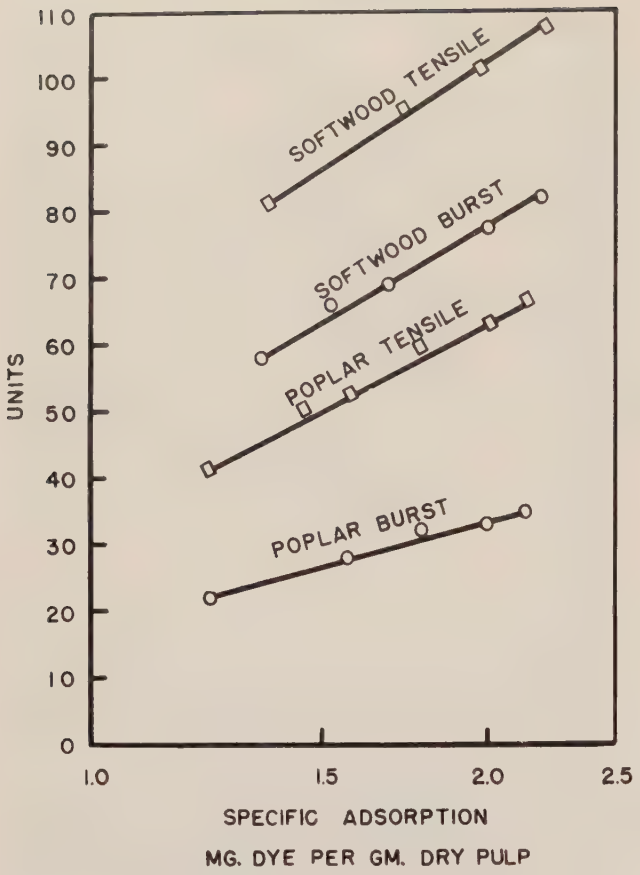

Fig. 7. Relation of physical properties to specific adsorption ("net"), sulphite pulps

down for these stocks. Recent information on the subject has been presented by Lyne and Gallay (*4*) who point out that some of the loss in burst, for example, is never regained by straight soaking. This is said by Jayme (*3*) to be a phenomenon of "irreversible cornification" (*Verhornung*) of the individual fiber, a permanent closing of some naturally occurring pits and crevasses in the fibers. Using swelling measurements, Jayme estimated the extent of this phenomenon to be about 35% when an unbleached sulphite pulp is oven dried. Hess and Gramberg (*2*), in their study of the take-up of the dye Congo Red on various pulps, cited the following data for ramie fiber: (all figures are dye take-up in per cent) unbeaten, air-dry, 5.4%; unbeaten, ovendry, 4.3%; beaten, air-dry, 19.2%; beaten, ovendry, 14.7%. A decrease of 20 to 23% in dye take-up upon going from the air-dry to the oven-dry state is thus observed. In comparing these data with those for wood pulp, the differences in the morphological characteristics of bast fibers as compared with woody fibers must not be overlooked.

Brief preliminary experiments made on this project so far have included dye adsorption tests and determinations of external specific surface by the silvering technique. A bleached softwood kraft pulp was steam dried and air dried to about 5% moisture content and then soaked in distilled water for 24 hr. The same procedure was followed with bleached poplar kraft pulp. In the case of the softwood pulp a decrease in dye adsorption of about 35% was noticed for the dried and rewetted pulp as compared with slush pulp. The decrease was about 25% for the hardwood pulp. The decrease in external specific surface was 2000 sq. cm. per gram or about 15 to 18% for both pulps. Percentagewise, the decrease in dye adsorption is much greater than that in external specific surface.

It is thought that the dye adsorption phenomenon may involve a greater portion of the surface than that on which the silvering technique operates, in that the dye can adsorb on the sides of submicroscopic fissures which the silver would tend to fill up and plate over.

Data cited by Lyne and Gallay (*4*) indicate that, even after beating, dried pulps never regain completely the values of tensile and burst possessed by the slush pulp beaten to the same freeness.

The loss in bursting strength is cited as about 20% for what is essentially air-dry pulp; the loss in tensile strength under similar conditions is about 35%. These strength changes are certainly comparable in magnitude with the changes in specific adsorption noted above. All indications coincide very well with the hypothesis of "irreversible cornification."

Any conclusion based on preliminary observations can be only tentative; indications are that changes in specific dye adsorption parallel changes in strength properties during drying. Experiments to determine the exact relationships are planned.

DISCUSSION

As stated in the introduction to the first paper in this series, the ultimate objective of this entire program is to see if the determination of specific dye adsorption is sufficiently useful and significant to have possibilities as a control test. Progress so far has largely consisted in defining specific circumstances in which the dye adsorption test appears to bear a valid relation to physical properties. It has been experimentally established that this relation exists during the course of beating either alkaline or acid pulp

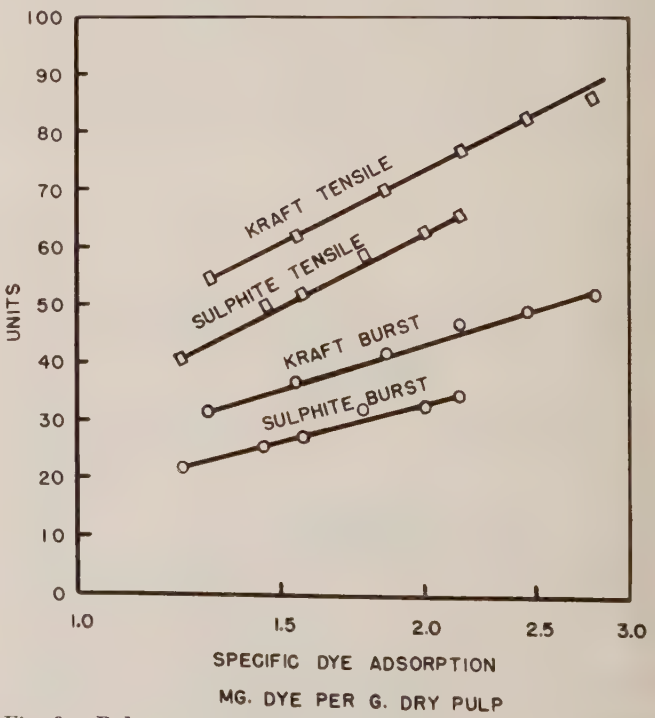

Fig. 8. Relation of physical properties to specific adsorption ("net"), poplar pulps

Table III. Specific Adsorption and Disperse Viscosity of Various Sulphite Pulps[a]

Sample	Source	Specific dye adsorption: With KCl	Specific dye adsorption: Without KCl	Specific dye adsorption: Difference	CED viscosity,[b] cp., 1% soln.
1	A	1.25	0.38	0.87	232
2	A	1.41	0.51	0.90	490
3	B	1.44	0.44	1.00	264
4	C	1.46	0.46	1.00	550
5[c]	D	1.17	0.00	1.17	754
6[d]	E	1.90	0.37	1.53	1124

[a] Samples of commercial sulphite pulp from five different mills.
[b] Data furnished by J. L. Parsons (7).
[c] Ammonia-base pulp.
[d] Mitscherlich pulp.

and that this relation holds irrespective of whether or not the potassium chloride "assistant" is used in the procedure. The relationship appears to hold during the course of bleaching of sulphite pulp, although it is yet to be seen what may occur in the case of a degraded pulp. Indications are that the relationship will hold during changes in drying.

On the negative side, it is apparent that dye adsorption cannot be employed as a unique measure of the strength potentialities of pulp, when comparing pulp from different sources. Nevertheless, further understanding of the phenomena involved may indicate a usefulness in such comparisons. The information in Table III is cited as an example of the unexplored possibilities.

With the cooperation of J. L. Parsons, who provided the viscosity measurements, adsorption and viscosity tests were run on samples of sulphite pulp from various sources. Four of the six points form a good linear relationship when dye adsorption in the presence of potassium chloride is compared with the cupriethylenediamine disperse viscosity of 1% solutions of the pulp. Sample no. 5, an ammonia-base pulp, deviates widely from this correlation, but this sample had zero adsorption in the absence of potassium chloride, as contrasted to about 0.4 to 0.5 mg. per gram for most of the other samples. If, therefore, the difference between values obtained with and without potassium chloride "assistant" are plotted against viscosity, a very good relationship is obtained, which, however, is nonlinear. The authors do not have an explanation as to the possible reasons for the apparent relationships cited, but feel that the significance may be appreciated if a series of exhaustive controlled experiments are made comparing dye adsorption properties with all important physical and chemical properties of a group of different pulp samples.

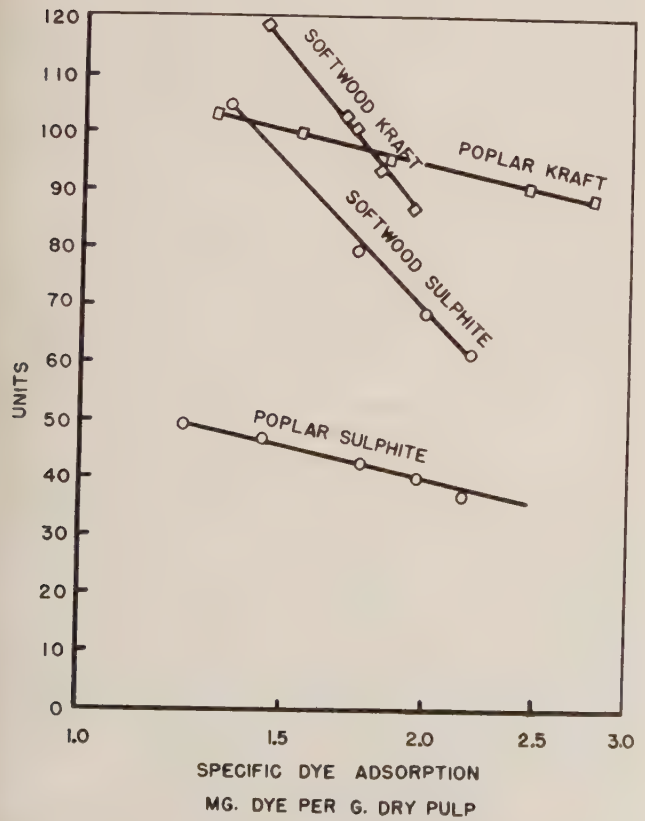

Fig. 9. Tear factor as a function of specific adsorption ("net")

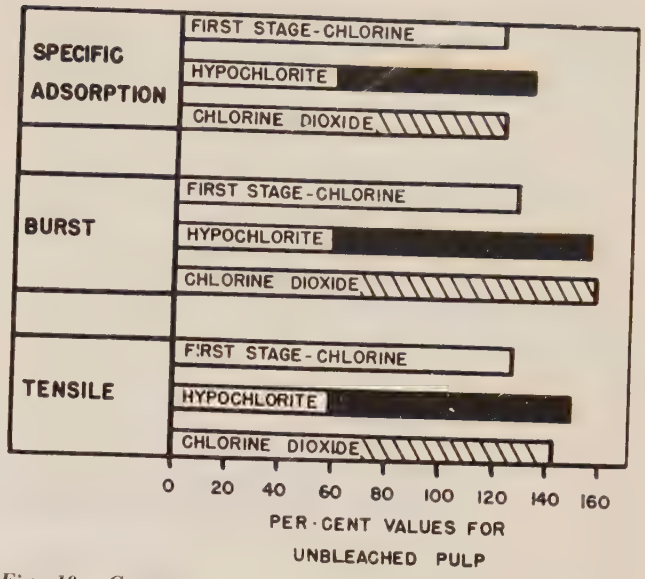

Fig. 10. Comparison of results—bleaching experiments

IMPORTANCE OF DYE STRUCTURE

The authors would be remiss to conclude this report of progress without a word of caution about overgeneralization from the results presented. Many of the relationships observed may be valid only for Benzo Fast Scarlet 4BSA and other products of the same Color Index number. This is because the molecular constitution of the dye is of extreme importance in determining its adsorption behavior on cellulose. The authors believe that *certain* of the empirical relationships presented are valid for a large number of direct dyes and that fundamental reasons therefor may be discovered. For the present, nevertheless, the conclusions herein presented should be understood to apply solely to the dyestuff Benzo Fast Scarlet 4BSA (C.I. No. 327).

CONCLUSIONS

It is concluded that changes in specific dye adsorption are related to the changes in physical properties of any given chemical pulp during the course of beating.

It is concluded that changes in dye adsorption parallel changes in physical properties of sulphite pulp during the normal course of bleaching. Dye adsorption experiments cannot be run on peroxide bleached pulps by the present technique.

Indications are, from preliminary observations, that changes in physical properties of pulp induced by drying are paralleled by similar changes in dye adsorption.

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A paper in the Maine Technology Experiment Station Series.

The Determination of Black Liquor Solids by Infrared Drying

PETER B. BORLEW and S. JEROME LANCASTER

Solid contents of residual pulping liquors, including those in the high range of sulphate black liquors, can be effectively determined by an infrared drying technique using a torsion balance which reads directly in per cent volatile matter with a 0.1% sensitivity. Data on kraft black liquor behavior toward infrared radiation; applied power output; and analyses comparing infrared, xylene distillation, and oven-drying methods are presented. The infrared method can be applied in a universal manner for rapid operational control as well as for accurate research purposes of solid contents. It also offers a tool for rapid indirect soda evaluations in kraft black liquors.

Evaporator and recovery operations as well as heat and material balance calculations require a knowledge of the solid content of black liquors in the pulp industry.

In reviewing the accepted, more or less accurate methods one is apt to find that a rapid and accurate one conveying the content of the sum of water and other volatile constituents of black liquors is not available. Evidently, every technical and operating man in the kraft industry would welcome such a method.

The principal disadvantage of commonly practiced methods, in particular those based on evaporation by oven drying as such (*1*), or with sand (*2*), or asbestos (*3*), to prevent the black liquor from blistering, splattering, and creeping up the walls of the receptacle, is their time-consuming feature ranging up to 48 to 72 hr. for high solid liquors if accurate results are to be expected. Some methods which consume less time are either not suitable for high solid content black liquors or are less accurate (*4*, *5*, *6*) than oven-drying methods. Less time-consuming but skilled attention-requiring, however, also more accurate, are methods based on the distillation of black liquor with water-immiscible organic solvents such as toluene or xylene (*7*, *8*). Analogously to a steam distillation the mixture of xylene and water distills at atmospheric pressure at a lower temperature than either of these would individually, thus accomplishing the same purpose as a vacuum distillation, more rapidly and without foaming. Some refinements in the technique of such a method when applied to moisture determinations in paper were recently published (*9*) and can be adapted profitably to solid content determinations of black liquors.

A different approach to the problem under consideration presented itself with the appearance of the so-called Karl Fischer method which consists in titrating the water or moisture content in a number of substances. Briefly stated, the method exploits the fact that SO_2 is oxidized to SO_3 by iodine in presence of H_2O, and the reaction stops when all H_2O is used up. Thus by titrating the excess of iodine the consumed amount of H_2O can be determined. It was first modified for black liquor solid determinations by Johansson (*10*) who substituted an electrometric end point for the color change as indicator and also introduced a correction for the iodine consumption due to the black liquor as such. It was recently suggested (*11*) to use this method for evaluating the total nonaqueous volatile constituents of pulp mill liquors by deducting the values as obtained for H_2O through the Karl Fischer method from the values as found by oven drying, which by its nature include not only the water but also volatilizable substances such as hydrogen sulphide, methyl mercaptan, and dimethyl sulphide. In other words, the Karl Fischer method, although it enables one to determine the water content of a black liquor, still does not convey its solids content. Although the Karl Fischer titration as such is a rather simple operation if the proper equipment is available, it appears to be cumbersome because the preparation of reagents requires professional skill and attention and, once prepared, these reagents are to be isolated rigidly from atmospheric moisture.

INFRARED DRYING

In searching for a universal method suitable for opera-

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tional control as well as for accurate work, the senior author conceived the idea to apply infrared drying in order to evaluate the residual solids from evaporation of black liquors.

As is easily realized, oven drying requires to heat first the air which transfers the heat to the black liquor. Similarly in the process of distillation, the glass flask is first heated and then in turn transfers the heat to the black liquor. The temperature to be applied is determined by the boiling point of the water under atmospheric pressure or when distilling with immiscible liquids by the temperature conditions of the binary system.

Infrared or radiant heating does not require any matter or object to serve as a medium of heat transfer. Infrared rays pass without contact from the hotter to the cooler body. Thus the increase of the temperature of the black liquor would be a function of its ability to absorb infrared radiation. Drying being proportional to the absorption of infrared rays, it should proceed very fast as they are readily absorbed by water. Consequently, a thin layer of black liquor subjected to radiant heat must be reducible in a short time to its solid content provided no interfering effects occur. The theoretical aspects of infrared heating and drying of possible interest to the pulp and paper industry were reviewed by Broughton (*12*), however no data pertaining to the behavior of black liquor toward infrared were disclosed by this author or, to our knowledge, by anyone else.

Coincidentally with efforts to find a practical way to embody the idea of infrared heating of black liquor in order to obtain the solids as residue, the Central Scientific Co. (Cenco) in Chicago advertised a new moisture balance, Catalog No. 26675, for rapid and accurate moisture determinations of a wide variety of materials (*13*). It utilizes the principle of drying a sample of approximately 5 grams by infrared radiation with either a 125 or a 250-w. General Electric infrared industry reflector 115 to 125-v. lamp or with an intermediate output varied by the use of an autotransformer between 0 to 135 v. Another feature of this instrument is a null point torsion balance. The scale of the balance is calibrated directly in per cent moisture graduated from 0 to 100% in 0.2% divisions and 0.1% can be estimated readily. The sample is placed in a light aluminum pan freely suspended on a pivot mounting. Expendable aluminum foil pans can be used on top of the regular pan for corrosive substances.

These features of the Cenco moisture balance seemed to cover our requirements for a tool to solve the problem. In midsummer 1952, the manufacturer was approached to verify in principle the possibility of the idea of infrared drying of sulphate black liquor in this type of balance and samples of different solid contents were forwarded to his laboratory. The returned results appeared very promising inasmuch as reproducible values were reported. However, it was not at all established whether or not the registered moisture was the "true" moisture or whether some decomposition going farther than and beyond drying took place. Subsequently, a Cenco moisture balance was purchased and has been in use in our laboratory since the end of 1952 for black liquor solids determinations based on the following studies.

EXPERIMENTAL PART AND DISCUSSION OF RESULTS

It was assumed from the beginning that values for black liquor solids by way of the infrared method will be reliable only if, as a result of the drying procedure, the moisture indicator remains constant for an appreciable lapse of time after reaching a maximum. When working with the 125-w. lamp at about 120 v. such a flattening out of a moisture versus time curve was obtained. However, if infrared heating is continued beyond this zone of constant values for moisture loss a further gradual increase of a few tenths of a per cent was noticeable and a second zone of constant values could be discerned. For instance, in a heavy black liquor sample the first zone of constant values would last from the 24th to the 32nd minute of infrared heating showing a moisture value of 49.7%, then gradually increasing to 50.2% at the 70th minute and remaining stationary to the 90th minute and beyond.

The 250-w. lamp at 80 v. proved to be too hot as dense smoke would appear rather early indicating some decomposition. Reducing the voltage for the 250-w. lamp to 70 v., on the other hand, unnecessarily slowed down the test without offering the advantage of a longer lasting or more distinct first zone of constant values. In this case, the above-mentioned black liquor would show moisture values increasing from 49.5 to 49.8% between the 25th and 60th minute. Reducing the voltage for the 125-w. lamp to 110 v. also proved superfluous.

Therefore, we adopted as standard operating procedure the use of the 125-w. lamp at about 120 v. Under this procedure, the first time zone of constant moisture values appears the earlier the thinner the black liquor. For instance, a less than 20% solids liquor offers constant values at the 18th, a 20% solids liquor at the 20th, a 50% solids liquor at the 25th minute, while a 60% solids black liquor may require 30 min. A periodic check of the actual voltage of the use of the autotransformer in view of possible line variations is recommended.

Another assumption which proved correct was that the first time zone of constant moisture values discloses the "true" value for the solid content. Initially, the oven method was used as a reference standard. It soon transpired that, as a rule, the moisture values as obtained by the infrared method were by a few tenths of a per cent higher than those obtained by oven drying. In most cases, heavy liquors showed a larger difference than thin liquors. These findings supported our hypothesis that values obtained during the first time zone must be closer to the accepted standards than any values which may result from a more intensive infrared heating. This was confirmed by a comparative study of all three methods, oven drying, xylene distillation, and infrared on black liquor samples from an identical batch. Typical results are presented in the following table of volatile matter of sulphate black liquors determined by different methods.

Amounts used for these comparative studies were approximately 5 grams for infrared, 20 to 40 grams for the xylene distillation, and 10 grams for oven drying. The Cenco balance is arranged in 500 subdivisions and readings between two neighboring subdivisions can be estimated down to 1 unit. Thus, by zeroing in ap-

proximately 5 grams the accuracy of weighing is limited to approximately five thousandths of a gram or 5 mg.

	Infrared, %	*Xylene distillation, %*	*Oven drying, %*
	39.9	40.0	39.4
	39.9	40.0	39.3
Liquor A, av.	39.90	40.00	39.35
	49.8	49.9	49.2
	49.7	49.8	49.1
Liquor B, av.	49.75	49.85	49.15
	81.8	82.0	81.3
	81.8	82.0	81.4
Liquor C, av.	81.80	82.00	81.35

Weighings for the xylene and oven-drying methods were carried out to the same accuracy limits. The results of this table are self-explanatory; however, it should be stressed that corrections for the meniscus in the xylene distillation method are subject to errors. In some quarters the xylene distillation is considered as being more reliable than oven drying because higher values for volatile matter are obtained indicating a more complete drying. Fundamentally speaking, the degree of accuracy of any of these three methods can only be determined if a sufficient amount of comparative data for a statistical study becomes available. *Prima facie* the infrared method appears to be as accurate as any of the hitherto accepted methods to determine volatile matter in residual pulping liquors. Further investigation will have to show whether or not a combination of the Karl Fischer method and the infrared method could lead to a rapid differentiation between the water and the volatile organic matter of these liquors.

In comparing methods to determine the solid content of black liquors, a word of caution as to the sampling technique is in order. Equally representative samples are, of course, easily secured from fluid or molten liquors in the lower solid content range. In working with high solid content liquors it is to be borne in mind that the liquor might have cooled down or solidified to an extent where fractional or partial crystallization of its components has taken place. Another source of errors is the gradual evaporation if the uncovered sample is exposed to room temperature. Therefore, in comparing methods it is mandatory to secure the individual samples as simultaneously as possible and preferably from a molten or at least heated and fairly liquid and well-stirred black liquor. However, once satisfied that the infrared method serves the purpose, liquefaction should be carried out only to a point where stirring becomes adequate to secure a representative sample and superfluous heating is to be avoided to prevent moisture losses.

A few preliminary studies will establish the proper power output and minimum time required to set up the infrared equipment in any part of the kraft mill. Mounting on rubber antivibrators facilitates undisturbed reading of final results. It is advisable to radiate infrared for a few minutes to dry out the pan then let it cool off before spreading thinly the sample and zeroing in the balance. It is recommended to place the moisture balance under a hood not only because of malodor emanation but also because the enforced draft is conducive to faster evaporation. An electric timer further reduces requirements for attention or for observation. Compared with ordinary oven drying infrared heating presents a much smoother picture of an effective evaporation of the water from black liquor. First, a bubble appears and the liquor seems to breathe gently; shortly afterwards, the bubble collapses and the drying proceeds almost imperceptibly to its end.

Some other benefits in mill operations control can be secured by applying the infrared method for solids determinations. As is well known, the ratio of Na_2O to total solids remains fairly constant if cooking and other factors are not drastically changed from day to day. Once a curve of black liquor solids and corresponding soda contents by the zinc-uranyl acetate method has been established further routine soda determinations can be substituted by less time-consuming infrared solids determinations.

In this connection, we spot checked the soda values of TAPPI Data Sheet 58 (Density and Soda Content of Black Liquor based on sulphate pulping of loblolly, slash, and longleaf pine) (*14*). In the region of higher solids the Na_2O content appears to be somewhat lower, e.g., for 58.5 and 51.0% the data sheet calculates 195 and 150 grams per liter while the figures found for our mill were 192 and 148 grams per liter, respectively. In the thinner liquors, the difference is less pronounced. Incidentally, this comparison is circumstantial evidence for the validity and reliability of the infrared method. Similarly degrees Baumé plotted against per cent infrared determined solids result in a straight-line curve.

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Determination of Cellulose by an Acid-Dichromate Method

A Comparative Study of Methods

THEODOR N. KLEINERT and WILHELM WINCOR

Combustion of cellulose and hemicelluloses by means of dichromate-sulphuric acid with and without the addition of silver sulphate as a catalyst was studied. Silver sulphate addition did not improve the combustion values. Heating the combustion mixture of dichromate-sulphuric acid (55% sulphuric acid by volume) without the addition of silver sulphate only to boiling proved to be the most suitable procedure for practical purposes. When proceeding in this manner, the "practical" milliequivalent weight of cellulose is 6.797 mg. Exact values corresponding to about 100% of the theoretical value were obtained when using the wet-combustion method by means of a solution of potassium iodate in concentrated sulphuric acid as suggested by R. Strebinger.

THE wet-combustion method using dichromate, sulphuric acid as an oxidizing agent is extensively used for the determination of alkali-soluble cellulose (*1–4*) as well as pulp constituents and degradation products of cellulose dissolved in the alkalizing liquors of the viscose fiber industry (*5*). In this method the constituents to be determined are oxidized by means of an excess of potassium dichromate in sulphuric acid and the excess of dichromate is determined by titration. The back titration may be carried out by means of sodium thiosulphate solution after the addition of potassium iodide or, directly, by means of a ferro ammonium-sulphate solution.

Doering (*2*), as well as Ohlsson (*3*), on investigating methods for determining the total amount of soluble cellulose and hemicelluloses, pointed out that the oxidation of cellulose or hemicelluloses by means of dichromate-sulphuric acid does not proceed quantitatively and yields values which are slightly lower than the theoretical values. Windeck-Schulze and Pieper (*6*) also found only 97% of the cellulose subjected to volumetric titration. A study (*7*) of the method of complete oxidation of fibrous cellulose by means of potassium dichromate and sulphuric acid showed that a certain small quantity of cellulose (about 1.66%) could not be accounted for. This deficit is caused by incomplete oxidation whereby small amounts of carbon monoxide are formed.

Following the publication of an article by Moore, Kroner, and Ruchhoft (*8*) which proved that the wet-combustion method by means of dichromate-sulphuric acid does not proceed quantitatively with all organic substances, Muers (*9*) pointed out that the results achieved by wet combustion of organic substances by means of dichromate-sulphuric acid, can be considerably improved or that oxidation can be completed by adding small amounts of catalytically acting silver sulphate to the reaction mixture. Moore and his coworkers (*10*), in further articles, have investigated and confirmed the effectiveness of the addition of silver sulphate during wet combustion of various organic substances by means of dichromate-sulphuric acid.

The following report deals with investigations whereby complete oxidation of alkali-soluble cellulose by means of dichromate-sulphuric acid was achieved in the presence or absence of silver sulphate as catalyst. The samples were heated with the reagent only to boiling, but, in some cases for comparison, they were boiled under reflux for 10 min. No essential differences were found. The results closely approximated the theoretical values. The time for boiling the samples was considerably reduced in contrast to prior methods of other authors. This fact makes the method especially suitable for practical purposes in the pulp and rayon industry. The method is of a particular advantage in view of the saving in time achieved thereby. All oxidations were carried out with a sulphuric acid concentration of 55% by volume. Comparative tests were carried out with glucose, with hemicelluloses from alkalizing lyes, and with bucked cotton. All tested materials were also subjected to wet combustion by means of iodic acid (*11*). The results obtained in these comparative experiments are shown in Tables I, II, and III.

Investigations made some time ago by Ladenburg (*12*) showed that complete oxidation of organic substances is achieved by wet combustion by means of silver iodate and concentrated sulphuric acid. Thereby no carbon monoxide is formed. R. Strebinger (*11*) studied the wet combustion of organic substances by means of potassium iodate and concentrated sulphuric acid and supplied detailed instructions for carrying out said process. Strebinger's method with minor variations, as they will be described below, was used in the present investigations. Oxidation was accomplished by means of a solution of concentrated sulphuric acid and moistened potassium iodate. The required amount of reagent was always weighed in a weighing pipet to increase accuracy. The effective value of the potassium iodate was determined, after dilution with distilled water, by titration with an $N/10$ thiosulphate solution which was standardized against C.P. potassium iodate.

The reagent was stabilized considerably by preliminary heating to 200°C., therefore it was not necessary to carry out blank tests with the reagent alone.

Table I illustrates comparative results obtained with dextrose and with a technical oxidized hemicellulose recovered from alkalizing lye. In these tests oxidation by means of dichromate-sulphuric acid was effected by heating the mixture to boiling for a short period of time. The silver sulphate content of the mixture, in all cases (Tables I to III), was 40 mg. of Ag_2SO_4 per tested sample

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Table I. Milligrams of Oxygen Consumed per 100 Mg. Moisture-Free Ash-Free Substance

Substance	Dichromate method: Without Ag_2SO_4	Dichromate method: With Ag_2SO_4	Iodate method
Dextrose	105.90	105.66	106.48
	105.74	105.66	106.68
	105.65	105.74	106.52
	105.76	105.68	106.56
	i.e., 99.23% of the theory	i.e., 99.16% of the theory	i.e., 100.00% of the theory
Oxidized hemicellulose (beta-cellulose)	116.43	116.18	116.61
	116.35	116.38	116.98
	116.18	116.10	116.80
	116.32	116.22	116.79
	i.e., 98.23% of the theory	i.e., 98.14% of the theory	i.e., 98.63% of the theory
	calculated as $C_6H_{10}O_5$		

(100 or 200 mg. of cellulose, respectively). Dextrose of the purest quality was used. Its water content was determined by titration with Karl Fischer's reagent. It amounted to 0.05%. The iodate method yielded, with dextrose, combustion values corresponding to 100% of the theoretical value. In contrast hereto, both dichromate values were always somewhat lower. It appears to be noteworthy that in all cases the dichromate value with the addition of silver sulphate was somewhat lower than the dichromate value without such addition. The difference is probably due to the fact that the titration end point is readily exceeded in the presence of silver sulphate, due to the formation of silver iodide.

With hemicellulose, a combustion value of, at the most, 98.63% of the theoretical value, calculated for $C_6H_{10}O_5$, was found. This apparent deficit over the expected 100% is due to the fact that, as was ascertained by separate investigations, its oxygen content is higher than that of cellulose and its composition differs therefrom (*14*) since hemicelluloses isolated from alkalizing lyes represent, in most cases, oxidation products with an increased oxygen content.

The combustion values found on oxidizing lyes containing hemicelluloses (Table II) are given in milligrams of oxygen consumed per gram of lye. The degree of oxidation of the material was not taken into account. It is evident that, in this case, the iodate method also yields the highest combustion value in comparison with the dichromate-sulphuric acid method. Combustion by means of dichromate-sulphuric acid without the addition of silver sulphate yielded only slightly different values, regardless of whether the sample was only heated to boiling or was boiled under reflux for 10 min. The lowest value was observed with the addition of silver sulphate.

The cotton sample tested, data for which are in Table III, was bucked for 8 hr. under a pressure of 3

Table II. Milligrams of Oxygen Consumed per 1000 Grams of Lye Containing Hemicellulose

Substance	Dichromate method: Heated to boiling	Dichromate method: Boiled under reflux for 10 min. without Ag_2SO_4	Dichromate method: Boiled under reflux for 10 min. with Ag_2SO_4	Iodate method
Lye containing hemicellulose	19.62	19.50	18.99	19.75
	19.63	19.35	19.15	19.80
	19.51	19.39	19.18	19.80
	19.59	19.41	19.11	19.78

Table III. Milligrams of Oxygen Consumed per 100 Mg. of Moisture-Free Ash-Free Substance

Substance	Dichromate method: Heated to boiling	Dichromate method: Boiled under reflux for 10 min. Without Ag_2SO_4	Dichromate method: Boiled under reflux for 10 min. With Ag_2SO_4	Iodate method
Purified cotton cellulose	117.66	117.67	117.43	118.28
	117.76	117.42	117.44	118.06
	117.65	117.92	117.60	118.31
	117.69	117.54	117.53	118.38
		118.02	117.50	118.47
		117.71		118.30
	i.e., 99.39% of the theory calculated as $C_6H_{10}O_5$	i.e., 99.49% of the theory calculated as $C_6H_{10}O_5$	i.e., 99.23% of the theory calculated as $C_6H_{10}O_5$	i.e., 99.90% of the theory calculated as $C_6H_{10}O_5$

atm. The alkaline bucking solution contained 2 grams of a wetting agent (Gardinol CA) per liter and was used in a proportion of 1 part of cotton to 8 parts of solution. The amount of sodium hydroxide in the bucking solution corresponded to 2.5% of the fiber material treated. Cotton purified in this manner was carefully washed with large quantities of hot water and, in an air-dry condition, possessed an ash content of only 0.063% and a water content of 4.58% (determined by Karl Fischer titration). As is evident from the table, the iodate method yielded, with this material, values of almost 100%. In contrast the values obtained on dichromate combustion without the silver sulphate addition were found to be 99.4% and with the silver sulphate addition 99.23%.

The addition of silver sulphate to the dichromate-sulphuric acid oxidation mixture, as suggested by Muers (*9*), did not yield any improved results in the case of cellulose or hemicelluloses, according to the present investigations. The iodate method, however, under the stated conditions, gave, in all cases, combustion values closely approximating the theoretical values. The combustion values obtained by means of dichromate-sulphuric-acid are also only comparatively slightly lower than the theoretical values. The "experimental" milliequivalent weight of 6.861 mg. suggested by Segal and co-workers (*15*) for the determination of cellulose by means of the dichromate-sulphuric acid method appears to be too high according to the results obtained in this study. When using as a base for determining the "practical" milliequivalent weight, the results obtained on oxidizing cotton by heating the cotton to boiling with an acid dichromate mixture in the absence of silver sulphate for a short period of time (Table III, column 1), a "practical" milliequivalent weight of 6.797 mg. is computed which is considerably closer to the theoretical value of 6.756. In this case, of course, exact determination of the water content of the samples to be tested (according to Karl Fischer's method) is essential.

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Filtration Through Paper

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The effect of the beating time of the stock upon the filtration efficiency of the sheet was investigated for hardwood soda pulp. With whole pulp stocks, two groups of experiments were made. In one, the stock was given no treatment other than beating; in the other, the beaten stock was dried and subsequently rewetted in order to form the sheet. In the first group of experiments, filtration efficiency decreased 33% and tensile strength increased 67% as beating time increased from 15 to 90 min. In the second group, however, neither filtration efficiency nor tensile strength was affected by beating time. A third group of experiments was made with stocks composed of the 24–50, 50–90, and 90–200-mesh fractions of pulp. In this group the beaten stocks were dried and subsequently rewetted. As in the case of whole pulp given similar treatment, the filtration efficiency of any particular fraction was independent of beating time. The filtration efficiency of the 90–200 mesh fraction was 54% lower than that of the 24–50-mesh fraction.

Experience has shown gas-filtration media prepared from papermaking materials to be satisfactory for both military and industrial purposes. Even though such paper filters are in widespread use, the manner in which their characteristics depend upon the techniques of their manufacture is not well understood. This paper reports a search for better understanding in the case of hardwood soda pulp.

In the design of filters, the pressure drop across the filter is often as important a consideration as the degree of penetration of particles through the filter. Consequently, a fair quantitative method for evaluation of the performance of filters should include the effects of both pressure drop and penetration. A rating which has not only proved acceptable in practice but which is based on sound theoretical concepts is filtration efficiency, γ, defined by

$$\gamma = \frac{100 \log_{10} (100/T)}{\Delta P}$$

T and ΔP symbolize penetration and pressure drop, respectively. In this study, these terms have the following restricted meanings:

T = the per cent of smoke particles entering a handsheet which passes through a section 100 sq. cm. in area (gas flow rate 32 liters per min., measured at 1 atm. and 70°F.)

ΔP = the drop in air pressure, in millimeters of water, across a section of the handsheet 100 sq. cm. in area (flow rate 85 liters per min., measured at 1 atm. and 70°F.)

Another important feature of filters made from papermaking materials is durability. Although it is difficult to evaluate this quantitatively, tensile strength serves as a rough indication.

During the course of a study of paper filters for military use, sponsored by the United States Chemical Corps, it became evident that all the major factors involved in paper production—the type of fibers used, the treatment of the stock, and the technique of manufacture of the sheet—influenced filtration efficiency. For any given fiber the relationships between filtration efficiency and the variables in the manufacture of the sheet, such as the method of formation, the size of the screen, the amount of wet pressing and the method of drying, were fairly well comprehended. The effect upon filtration efficiency of treatment of the stock, however, was not clear. This study was initiated in order to clarify partially the effect of beating upon filtration efficiency.

Care was taken to hold the apparent density of the sheets constant while beating time was varied, since filtration efficiency is extremely sensitive to apparent density. (Apparent density, in this paper, refers to the weight of the sheet in grams divided by its volume in cubic centimeters.)

The pulp used was bleached hardwood soda, cooked from a mixture of poplar, birch, beech, and maple woods. This pulp was obtained from the Penobscot Chemical Fibre Co., Great Works, Me., where it was manufactured by the standard soda process and bleached with chlorine and calcium hypochlorite. Such a pulp was chosen because from it is formed a uniform sheet free from the clots sometimes found in sheets made from longer fibered pulps.

GENERAL PROCEDURE

At any given set of experimental conditions, ten handsheets were made and tested as follows: 50 grams of hardwood soda pulp were charged to a TAPPI standard beater. All beating was done with no load on the bed plate, at a stock consistency of 0.6% and a temperature of about 20°C. Tap water from Orono, Me., was used.

Handsheets were formed in a TAPPI Standard (205 m-45) sheet machine having a 150-mesh wire, the

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amount of stock used being regulated so as to give a dry weight of 2.2 grams to the finished sheet. Stock consistencies were adjusted to 0.5% for sheet formation.

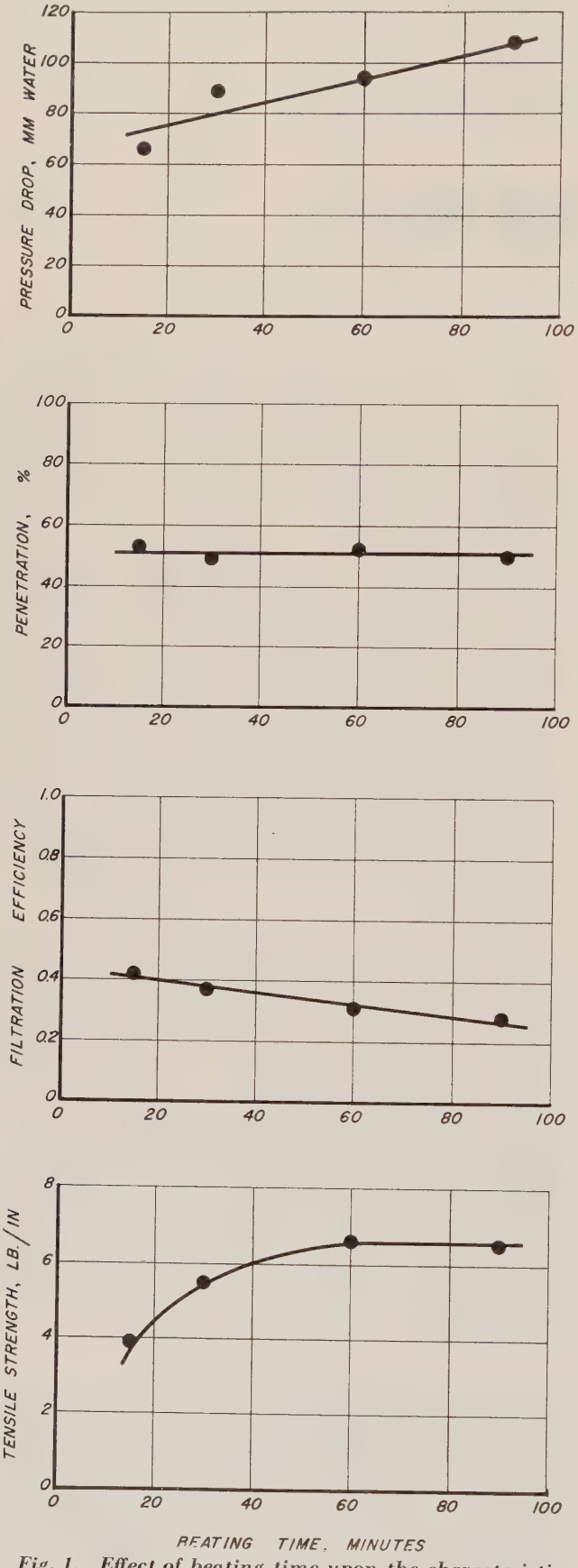

Fig. 1. Effect of beating time upon the characteristics of sheets made from whole pulp—stock untreated after beating

The apparent density of the sheet was regulated by varying the number of times the couch roll was passed over the newly formed sheet before removal of the

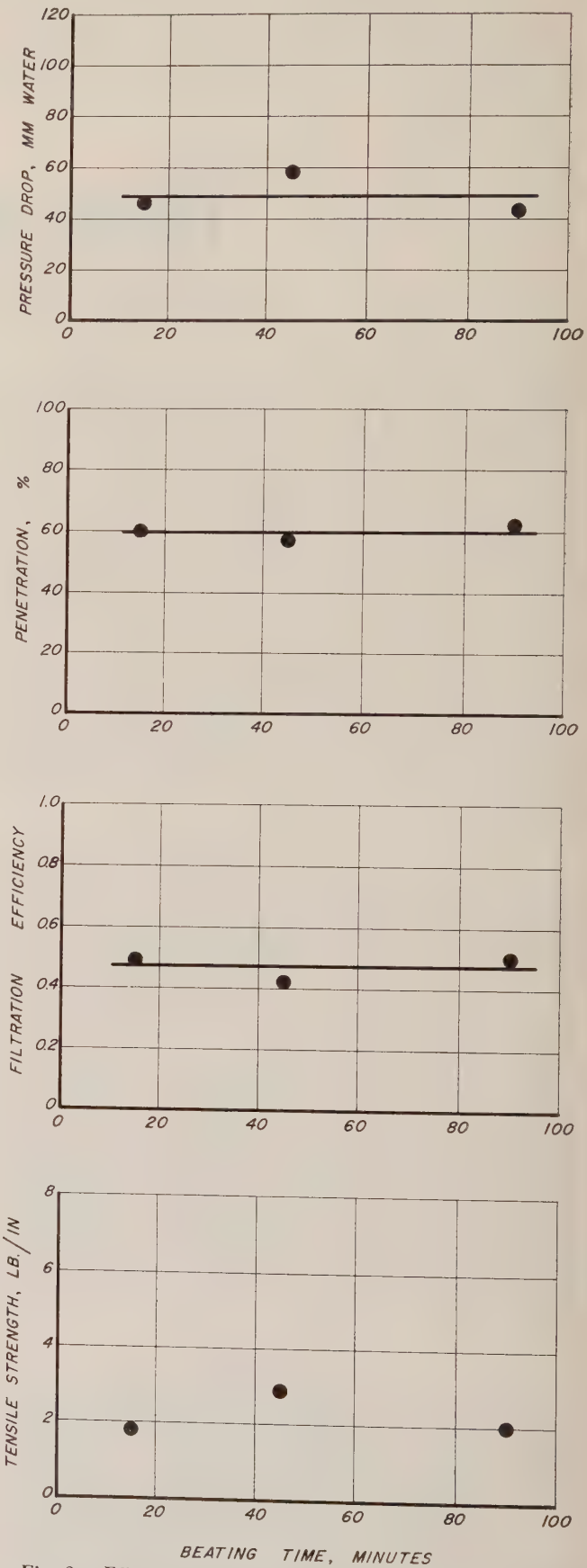

Fig. 2. Effect of beating time upon the characteristics of sheets made from whole pulp—stock dried after beating

sheet from the wire. Preliminary tests indicated the number of passes at each beating time necessary to produce the desired density in the finished sheet. Under the same conditions of formation, density was observed to increase with beating time, so that fewer passes were required as beating time increased. The handsheets were dried flat on blotters in a forced draft oven maintained at 60°C.

After having been dried, sheets were weighed on an analytical balance. The thickness of each sheet was then determined as the average of ten measurements over its surface with a Schopper paper micrometer. All sheets had an area of 201 sq. cm.

The pressure drop was measured at an air flow rate of 85 liters per min., and the penetration was measured at a smoke flow rate of 32 liters per min., both volumes being at 1 atm. and 70°F. A sheet area of 100 sq. cm. was tested in all cases. Determinations were made on standard United States Chemical Corps equipment. The smoke consisted of liquid particles of dioctyl phthalate dispersed in air. On the average, the particle size was 0.3 mu. The particle concentration was 100 mg. per liter.

The first measurements made on a sheet were those of pressure drop and penetration. After these had been completed, strips were cut from the sheet and the tensile strengths of these strips were determined on a Scott Model X-5 tensile tester with a scale range of 5 lb. The average of the strengths of the strips was taken as the tensile strength of the sheet.

Thickness and tensile tests were conducted in a room maintained at 73°F. and 30% relative humidity.

DISCUSSION OF RESULTS

Effect of Beating Time on the Characteristics of Sheets Made from Whole Pulp

Stock Untreated After Beating. At constant apparent density, the effect of increasing the time of beating is to increase the pressure drop but leave the penetration unchanged. In order to ascertain this, four groups of ten handsheets each were made from whole pulp stocks identical in all respects except beating time; one stock had been beaten for 15, the next for 30, the next for 60, and the last for 90 min. The pressure drop, penetration, and tensile strength of each sheet were measured. The results are plotted in Fig. 1. As beating time increases from 15 to 90 min., pressure drop increases from 66 to 108 mm. of water, while penetration stays constant at 50%. Consequently, there is a decrease in filtration efficiency from 0.42 to 0.28.

It is well known in the industry that beating decreases porosity and thus decreases permeability. The increase in pressure drop with beating is therefore as expected. The invariance of penetration with beating is, however, not exactly as expected, and the reason for this invariance is not clear. Possibly beating slighty decreases the effective diameter of the capillaries in the sheet without changing their tortuosity.

In Fig. 1 is plotted also the familiar curve of increased tensile strength with increased beating time. Comparison of this graph with that of filtration efficiency versus beating time emphasizes the problem usually faced by the designer of paper filters: tensile strength can be raised only at the expense of lowered filtration efficiency.

Stock Dried After Beating. A remarkable difference in the effect of beating time upon pressure drop and

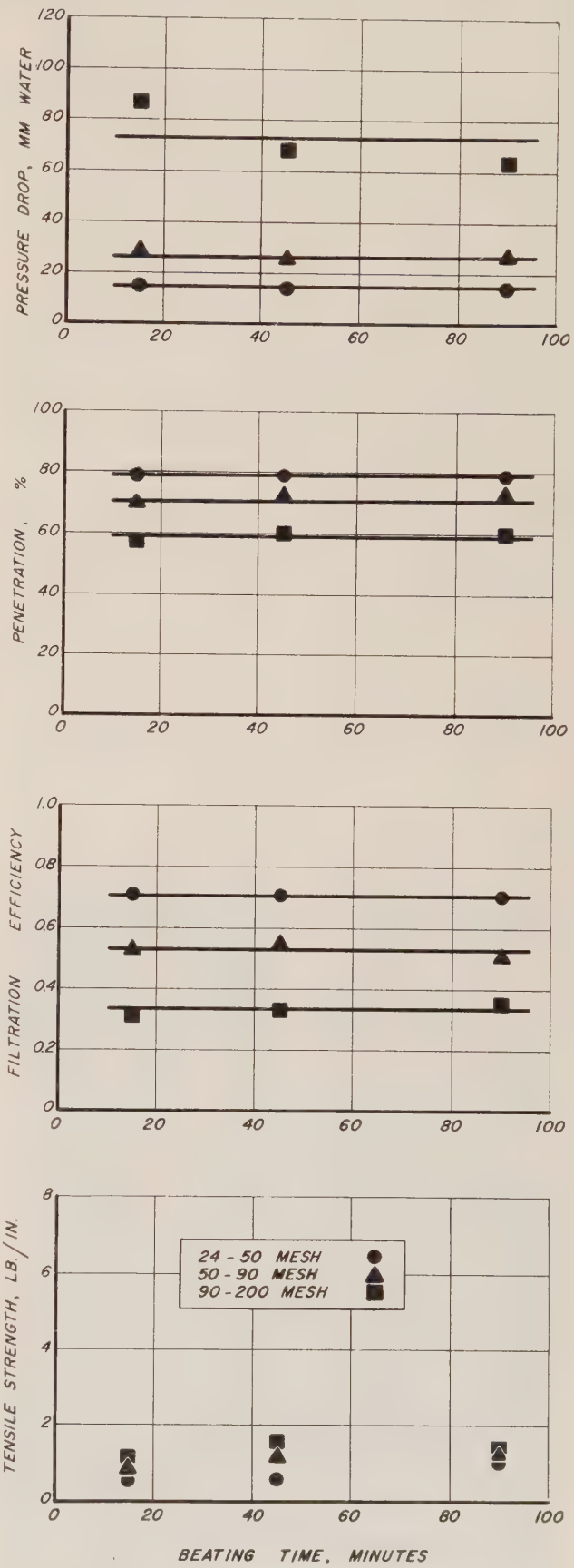

Fig. 3. Effect of beating time upon the characteristics of sheets made from pulp fractions—stock dried after beating

tensile strength occurs. As the charts of Fig. 2 indicate, beating time has no significant effect upon either pressure drop or penetration and thus has no effect upon filtration efficiency. The pressure drop at 45 min. beating time is high, and the penetration is low, because the sheet density was 0.018 gram per cc. higher at 45 min. than at the other two beating times. Apparent densities are listed in Table I. As will be discussed below, the data of Fig. 3 also support the invariance of pressure drop and penetration with beating time. It has no great effect upon tensile strength, although since the apparent changes in tensile strength are within the limits of the large errors in measurement incurred at low values of tensile strength, no line is drawn through the points.

The procedure used to obtain the values given in Fig. 2 was as follows: from a whole pulp stock were taken three portions. One was beaten for 15, another for 45, and the last for 90 min. Free water was then drained off, and the moist pulp was dried. Each portion was then redispersed, and handsheets were made.

Comparison of Figs. 1 and 2 shows that filtration efficiencies are higher, and tensile strengths are lower, in the case when the stock is dried after beating. For example, at 90 min. beating time, the filtration efficiency of sheets from dried stock is 0.47, while that of sheets from undried stock is only 0.28; the respective values of tensile strength are 2.2 and 6.5 lb. per in. The drying process alone may not be responsible for these variations because, as can be seen from Table I, the apparent densities of the sheets in the runs on undried stock averaged 0.283 gram per cc. and those in the runs on dried stock were lower, averaging 0.237 gram per cc.

Effect of Beating Time on the Characteristics of Sheets Made from Pulp Fractions—Stock Dried After Beating

As in the case of whole pulp, there is for any particular fraction no change in pressure drop or penetration with beating. These facts are illustrated by Fig. 3. For example, regardless of beating time the pressure drop of the 50–90-mesh fraction remains at 27 mm. of water and the penetration at 72%. Consequently, the filtration efficiency remains constant at 0.53. Data were obtained in the following manner: a whole pulp was divided into three parts. One was beaten for 15, another for 45, and the third for 90 min. Each part was then classified for 4 hr. in an Appleton selective screen. After the preliminary classification, the fractions retained on the 50, 90, and 200-mesh screens were saved, but those fibers retained on the 24-mesh screen and those which passed the 200-mesh screen were discarded. The 50, 90 and 200-mesh fractions were then separately reclassified. The fibers retained on the 50-mesh screen in each of the three reclassifications were combined to give the 24–50-mesh fraction discussed in this paper; likewise, the fibers retained on the 90-mesh screen were combined to give the 50–90-mesh fraction and the fibers retained on the 200-mesh screen were combined to give the 90–200-mesh fraction. As in the first classification, both those fibers retained on the 24-mesh screen and those passing the 200-mesh screen were discarded. Each of the three final fractions was drained, dried, and subsequently dispersed in a slurry of 0.5% consistency for handsheet formation.

Table I. Apparent Densities of the Handsheets

Mesh on which retained	*Beating time, min.*	*Apparent density, g./cc.*
A. Whole Pulp, Stock Untreated After Beating		
...	15	0.276
...	30	0.288
...	60	0.278
...	90	0.292
B. Whole Pulp, Stock Dried and Subsequently Rewetted After Beating		
...	15	0.234
...	45	0.249
...	90	0.229
C. Pulp Fractions, Stock Dried and Subsequently Rewetted After Beating		
50	15	0.221
50	45	0.221
50	90	0.220
90	15	0.232
90	45	0.221
90	90	0.226
200	15	0.232
200	45	0.228
200	90	0.227

As in the case of whole pulp with the stock dried and rewetted after beating, tensile strength measurements were not precise enough to enable lines to be drawn in Fig. 3. Examination of this graph shows that, in general, sheets from the largest fibers have the lowest tensile strengths. However, sheets made from the largest fibers had larger filtration efficiencies than sheets made from the smallest fibers. The 24–50-mesh fraction, for example, yielded sheets with an average filtration efficiency of 0.71, whereas the 90–200-mesh fraction yielded sheets with an average filtration efficiency of 0.33.

Although the pressure drop and penetration of the fractions are comparable to those for whole pulp, the tensile strengths of the fractions are much lower than that for whole pulp. Thus, the pressure drop of whole pulp sheets prepared from dried stock was 49 mm. of water, a value which lies between that of 73 for the largest fibers and 14 for the smallest. The penetration of whole pulp sheets, 60%, is about the same as that of the largest fibers, 59%. The tensile strength of whole pulp sheets, however, is 80% higher than the highest tensile strength of the three fractions.

CONCLUSIONS

For stock untreated after beating, at constant apparent density, increasing beating time increases pressure drop and tensile strength, has no effect upon penetration, and decreases filtration efficiency.

For stock dried after beating, at constant apparent density, increasing beating time has no effect upon either pressure drop, penetration, filtration efficiency, or tensile strength. This is true both for sheets made from whole pulp and for sheets made from fractions of whole pulp.

For stock dried after beating, at constant apparent density, sheets made from pulp fractions composed of small fibers have higher pressure drops and tensile strengths, but lower penetrations, than sheets made from pulp fractions composed of large fibers. Filtration efficiencies are higher for sheets made from large fibers.

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Evaluation of Refiner-Plate Designs Used for Experimental Processing of Hardboard Stocks

H. DALE TURNER

The effects of dissimilar plate designs used in a disk refiner for processing hardboard pulp upon stock drainage time, board strength, and energy consumed in milling the stock were investigated by means of a 5-hp. single-rotating-disk attrition mill. Experimental data involving three plate designs and various milling conditions are presented in tabular and graphical form. The ratio of hardboard bending strength to energy consumed in milling the stock, herein defined as the energy index, is a significant measure of plate performance. This index is essentially constant for a single plate design throughout a wide range of pulp quality, but dissimilar designs may show index values differing by as much as 400%. The effect of plate rotation direction upon stock drainage time and board strength is significant and measurable. The effect of plate design on drainage time is large; a range of 300% in drainage time was observed for equal-strength boards made from pulps which were refined with dissimilar disk patterns.

THE application of rotating-disk mills for fiber processing, or refining, is an accepted procedure in several branches of the pulp and paper industry. The use of this equipment in the production of coarse fiber stocks for insulation board, wallboard, and hardboard is particularly prominent.

A general description of rotating-disk mills is given in reference (*10*), while a specially modified disk mill for fiber reduction in a steam atmosphere is described in (*7*). Other pertinent papers on similar related fiber-processing machines are references (*1–4, 6, 8, 9, 12*). The investigation of the disk-type mill is advantageous from an experimental standpoint, since these machines are available in several sizes, they are important industrially, and the ease of changing their fiber-contacting elements provides unusual flexibility.

The evaluation of refiner performance in fiber processing is difficult and often confusing because of the diverse quality characteristics desired in the resultant fiber. There are factors of sheet quality, such as tensile strength, toughness, resistance to tearing, resistance to bursting, and uniformity, that, in a sense, reflect fiber quality potentially present in the wet state. These intrinsic wet-state qualities are subtle, hard to define, and difficult to measure with precision. For example, the measurement of a seemingly simple characteristic, drainage quality, has prompted the development of several test units, designed especially for fast-draining stocks, that are not wholly satisfactory in their ability to discriminate between pulps of known operational behavior (*5*).

In this paper, an experimental method is presented for evaluating several milling variables encountered in the preparation of hardboard-type stocks. Specifically, the effects of dissimilar refiner-plate designs upon stock drainage time, board strength, and energy consumed in milling the stock were investigated.

PROCEDURE AND EXPERIMENTAL EQUIPMENT FOR FIBER PROCESSING

For the comparison of effects of refiner-plate designs, a 5-hp. single-rotating-disk attrition mill was used for fiber processing. This machine and its associated equipment are shown in Fig. 1. The rotating disk of the mill could be driven clockwise or counterclockwise, and the clearance between plates was controlled with a lock screw device attached to the rotating shaft. The normal speed of this disk was 3450 r.p.m.

Interchangeable grinding disks, 8 in. in diameter, were available for the mill (Fig. 2). The four disks used in this work were: plate A—intermeshing knobs; plate B—closely spaced radial serrations at a 0° angle, closed edge; plate C—spiral channels, open edge, radial serrations at approximately a 16° negative angle; and

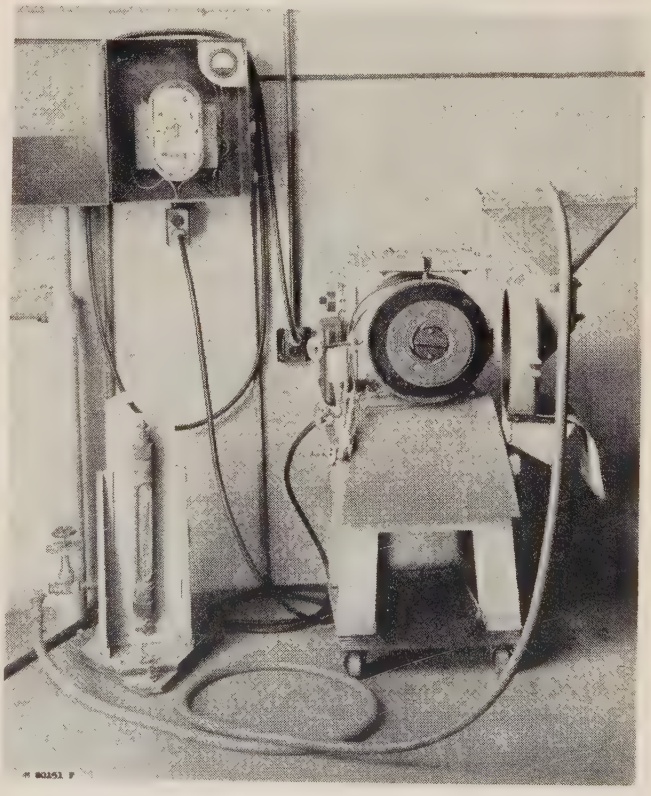

Fig. 1. A 5-hp., single-rotating-disk refiner

Watt-hour meter at upper left; water-flow meter at lower left.

H. DALE TURNER, Chemical Engineer, Forest Products Laboratory, maintained at Madison, Wis., in cooperation with the University of Wisconsin. Forest Service U. S. Department of Agriculture. Presently employed at Olin Industries Inc., East Alton, Ill.

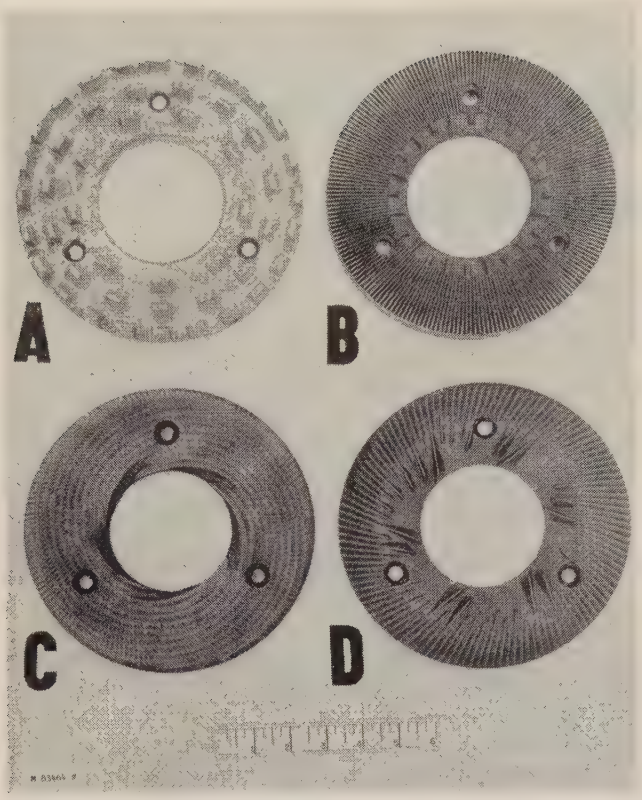

Fig. 2. Interchangeable plate designs employed in a single-rotating-disk refiner

plate D—deep radial serrations at approximately a 14° positive angle, open edge.

The source of fiber was 600-gram (dry basis) charges selected from a blended lot of steam-cooked second-growth Douglas-fir. Sufficient bark-free chips at an initial solids content of 45% were digested with direct steam for 15 min. at 170°C. The digester was relieved several times as full pressure developed. Duplicate cooks were thoroughly blended to provide a single homogeneous lot for all milling trials.

Preliminary experiments showed that a primary reduction of the chips via passage through plate A was desirable. The coarse splinterlike product from this grind assured uniform motor loading in final processing.

The chips were manually fed through the center opening in the stationary disk of the mill along with a

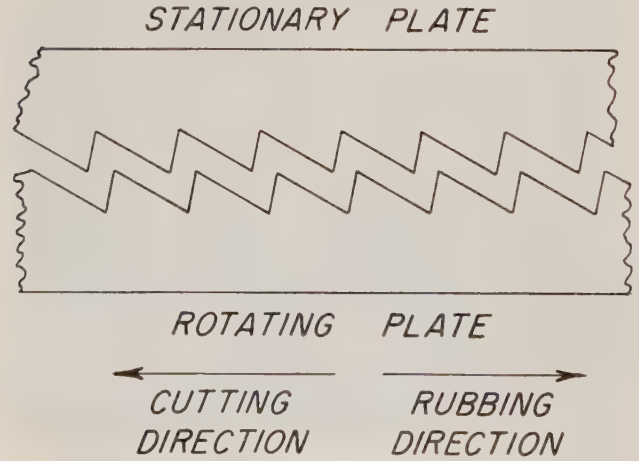

Fig. 3. Diagrammatic sketch of a cross section of the working surface of a refiner disk

Table I. Pulp Processing Conditions and Data on Drainage Time and Fiberboard Strength Obtained in Checking a Technique for Small-Scale Evaluation of Steam Digestion and Milling Procedures with Douglas-Fir

Pulp lot	Fiber processing variables: Grinder plate No. 10	Plate clearance, in.	Plate rotation direction	Water flow, gal./hr.	Energy consumption: Energy consumed,[a] kw.-hr.	Weight of charge dry basis, g.	Unit energy consumed, kw.-hr. per ton	Total unit energy consumed,[b] kw.-hr. per ton	Drainage (Williams test): Weight of sample, dry basis, g.	Observed, sec.	Adjusted to 8-g. basis, sec.	Strength: Panel A: No. of tests	Panel A: Av. specific gravity	Panel A: Av. modulus of rupture, p.s.i.	Panel A: Adjusted modulus of rupture,[c] p.s.i.	Panel B: No. of tests	Panel B: Av. specific gravity	Panel B: Av. modulus of rupture, p.s.i.	Panel B: Adjusted modulus of rupture,[c] p.s.i.	Av. adjusted modulus of rupture, p.s.i.	Energy index[d]
1	B	0.000	Cutting	140	1.82	602	2740	2760	8.13	400	400	0	...	...	...	3	1.02	8130	7940	7940	2.88
2	B	0.002	Cutting	140	1.87	615	2760	2780	8.82	350	300	3	1.08	9430	8130	0	...	...	...	8130	2.92
3	B	0.008	Cutting	140	1.46	593	2240	2260	8.15	130	127	3	1.02	7560	7270	3	1.00	7170	7120	7200	3.19
4	B	0.020	Cutting	140	1.03	610	1590	1610	9.70	130	95	3	1.02	6100	5830	3	1.03	5650	5360	5600	3.48
5	B	0.000	Rubbing	140	2.27	611	3370	3390	8.26	390	375	3	1.05	9130	8280	2	1.05	8050	7300	7790	2.30
6	B	0.020	Rubbing	140	1.58	588	2440	2460	7.90	105	108	3	1.02	4840	4020	3	1.05	4480	4090	4360	1.77
7	B	0.008	Rubbing	140	2.02	616	2980	3000	8.80	140	120	3	1.04	6790	6270	3	1.07	7090	6160	6220	2.07
8	C	0.000	Cutting	140	0.45	617	660	680	7.50	37	41	3	1.05	7020	6330	3	1.06	6350	5690	6010	8.84
9	C	0.008	Cutting	140	0.43	634	615	635	7.88	20	21	3	1.06	6120	5480	3	1.05	5960	5440	5460	8.60
10	C	0.000	Cutting	70	.71	630	1020	1040	8.52	295	270	3	1.02	7240	7000	3	1.05	8130	7380	7190	6.91
11	C	0.020	Cutting	140	0.41	627	595	615	7.75	19	20	3	1.02	4940	4710	3	1.05	4500	4110	4410	7.17
12	C	0.000	Rubbing	140	0.56	601	845	865	7.45	115	127	3	1.07	7910	6910	3	1.05	7910	7180	7040	8.14
13	C	0.008	Rubbing	140	0.51	608	760	780	7.40	52	59	3	1.04	7040	6470	3	1.06	6820	6090	6280	8.05
14	C	0.020	Rubbing	140	0.45	600	675	695	7.40	35	40	3	1.05	6130	5560	3	1.07	6090	5350	5460	7.86
15	C	0.000	Rubbing	70	0.84	609	1250	1270	8.68	435	380	3	1.03	8350	7820	2	1.14	8440	6430	7120	5.61
16	C	0.000	Cutting	170	0.43	601	650	670	9.44	40	30	3	1.06	6200	5520	3	1.08	6720	5790	5660	8.45
17	C	0.000	Cutting	210	0.38	596	580	600	9.30	36	27	2	1.09	5600	4700	3	1.09	7520	6350	5520	9.20
18	C	0.000	Cutting	130	0.48	604	720	740	8.15	68	65	3	1.06	7270	6510	3	1.05	7110	6410	6460	8.73
19	C	0.000	Cutting	100	0.47	605	705	725	7.93	68	70	3	1.06	7040	6300	3	1.07	7080	6220	6260	8.63
20	B[e]	0.000	Cutting	130	1.17	598	1770	1790	8.06	400	400	2	1.15	5500	4160	2	1.06	6550	5760	4960	2.77
21	D	0.000	Rubbing	130	0.28	603	420	440	8.84	34	29	3	1.05	4960	4530	3	1.06	5030	4510	4520	10.27

[a] Energy consumed in making the final pulping grind.
[b] Includes energy consumed in making the initial coarse grind with plate A.
[c] Modulus of rupture adjusted to specific gravity of 1, based on ratio of squares of specific gravity values as given by the equation $S_2^2/S_1^2 = R/R_1$, where S and R are the observed values for specific gravity and strength and R_1 is the computed strength at the specific gravity S_1 chosen as the basis for comparison.
[d] Energy index is: modulus of rupture/p.s.i./kilowatt-hours per ton of dry pulp.
[e] Plate B modified by grinding off peripheral face edge to 45° bevel so as to provide edge channels.

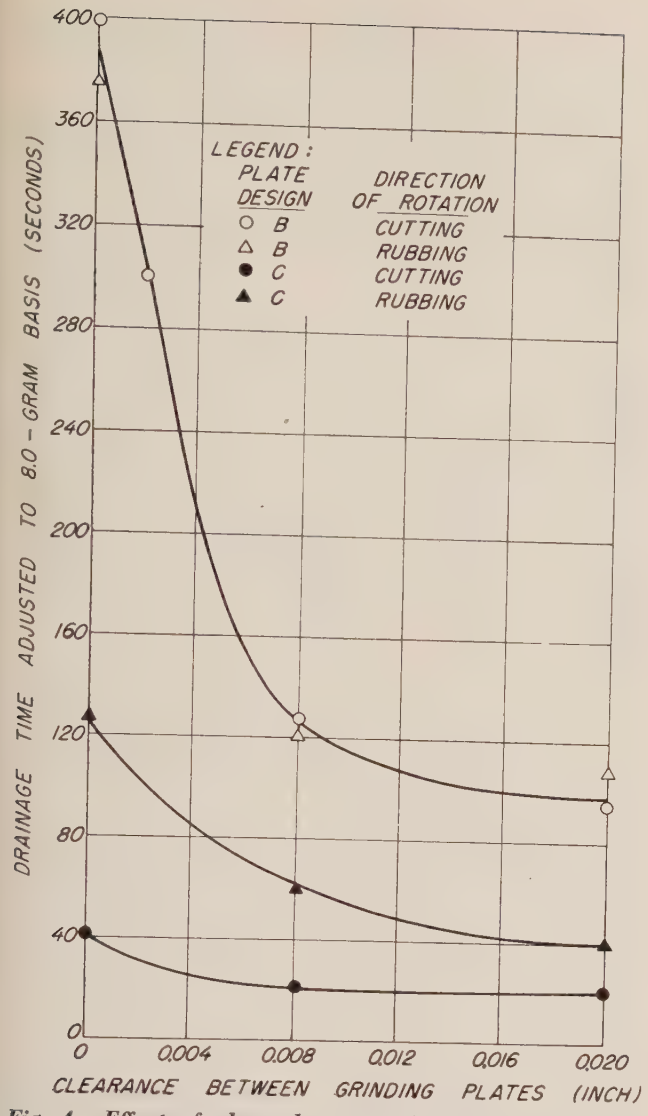

Fig. 4. Effect of plate clearance, design, and direction of rotation on drainage quality of pulp. Drainage test conducted in a Williams Precision Tester. Experimental drainage time adjusted to 8-gram basis

stream of water to facilitate chip entry and processing action. The rate of water flow was held constant for all runs, but the discharge consistency varied, since the rate of feed altered unavoidably with changing degrees of fiber processing.

Direction of disk rotation was an essential variable, since the toothlike projections or ribs of the plates were not symmetrical. The sketch in Fig. 3 shows the principle described. In this drawing the angles have been intentionally exaggerated for illustrative clarity.

In the milling trials, the experimental procedure was as follows: (1) the water-flow rate and plate clearance were adjusted and plate rotation direction was noted; (2) initial watt-hour meter reading was recorded; (3) the entire lot (600 grams, dry basis) was milled, and the load on the motor was maintained as nearly constant as feasible; the processed stock was collected in an 80-mesh screen-bottom box; and (4) the final watt-hour meter reading was recorded.

The milled pulp was dewatered to a solids content of about 15% on a small suction box, blended, and separated into suitable amounts for conversion into hardboard test sheets and a drainage test. Unsized hardboard test panels 10 by 10 in. by approximately 0.20 in. were made in duplicate. They were press-dried at 190°C. for 20 min. at a pressure of 500 p.s.i. The dry panels were weighed immediately on removal from the hot press.

Sizing was omitted, since its effect on strength is sometimes erratic and tends to obscure interpretation of fiber-processing effects.

TESTING PROCEDURE

Drainage Test

The drainage test was conducted with a Williams Precision Tester. Observed results were adjusted to correspond to the drainage time for an 8-gram sample (dry basis).

Strength Test

For strength comparisons, the hardboard panels were conditioned for 30 days at 75°F., 65% relative humidity; specimens 2 in. wide were cut and reconditioned before testing. The modulus of rupture in bending was determined in accordance with American Society for Testing Materials tentative method D 1037–49 T; a 4-in. span was used. Specific gravity was based on the specimen's weight and volume at time of test.

In order to make valid strength comparisons it is

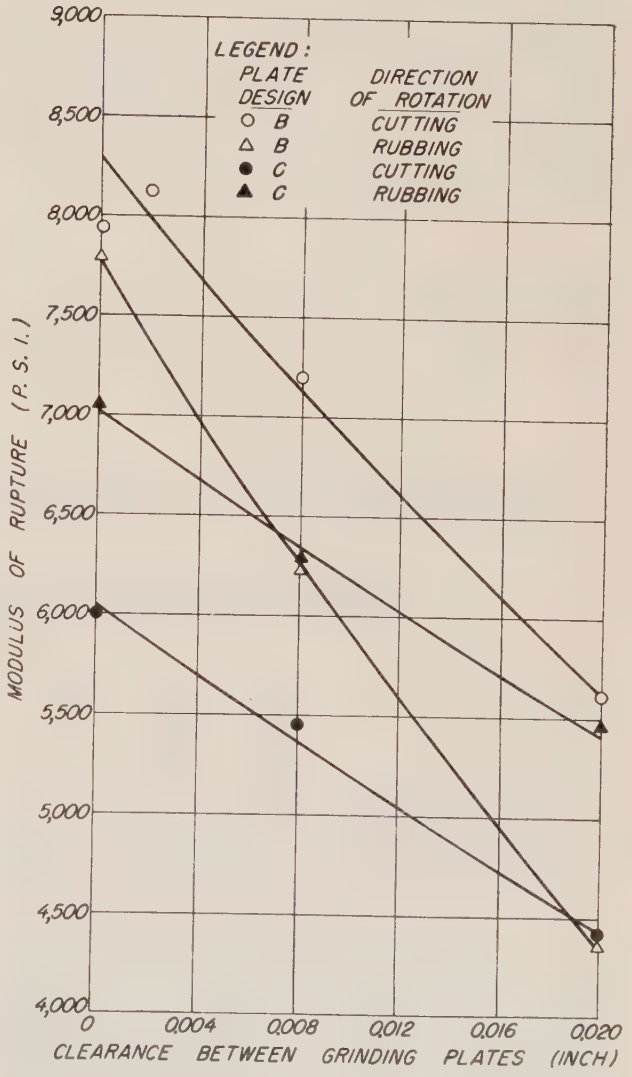

Fig. 5. Effect of plate clearance, design, and direction of rotation on hardboard strength

necessary to adjust observed values so that they correspond to a uniform specific gravity basis. This adjustment involves an experimentally determined relationship, which states that, for identically made fiber stock, the strength varies with the square of the specific gravity (*11*). The observed values were adjusted to a specific gravity basis of 1.00.

Milling Energy Consumption

The net watt-hour meter readings indicated the energy consumed for each milling run. The total dry weight of processed fiber was based on the weight of the press-dried panels and the oven-dried drainage-test pad. The unit energy consumed, in kilowatt-hours per dry ton, was calculated from these data. No correction was made for motor efficiency or other energy losses. In general, the final grind was done within ±15% of full motor load.

The bulk of the experimental work described here deals with a comparison of plates B and C. Some trials were made with a slightly modified plate B, and a single run was made with plate D. The data on these tests are presented in Table I.

PRESENTATION AND DISCUSSION OF RESULTS

The comparative influence of plate design, direction of plate rotation, and clearance between plates upon drainage quality is shown in Fig. 4.

The extreme range in fiber quality is plainly evident. The effect of rotation direction is of negligible importance with plate B, but is definitely significant in the case of plate C. From a practical point of view, the curves of Fig. 4 represent, from top to bottom, a use-

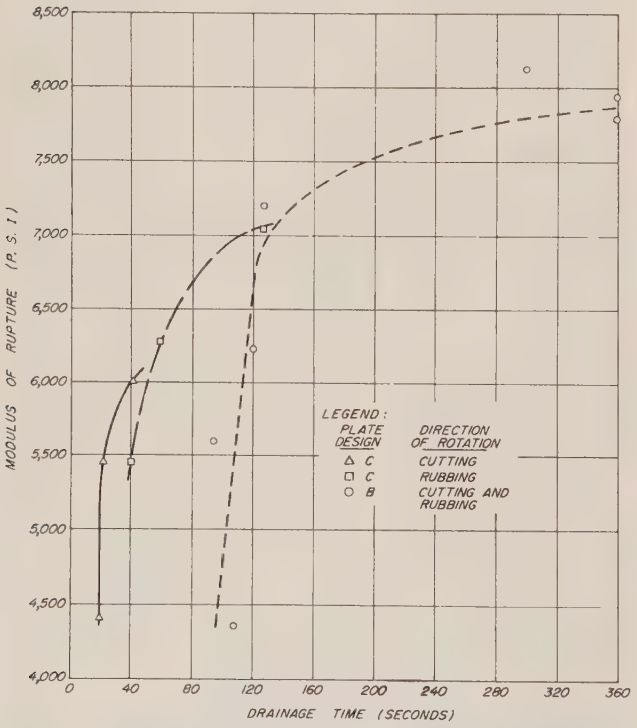

Fig. 6. Relation of hardboard strength to drainage time of pulps processed in a 5-hp. refiner, with two different types of plates at various clearances and opposite directions of plate rotation. Drainage test conducted in a Williams Precision Tester. Experimental values for modulus of rupture adjusted to specific gravity basis of 1.00

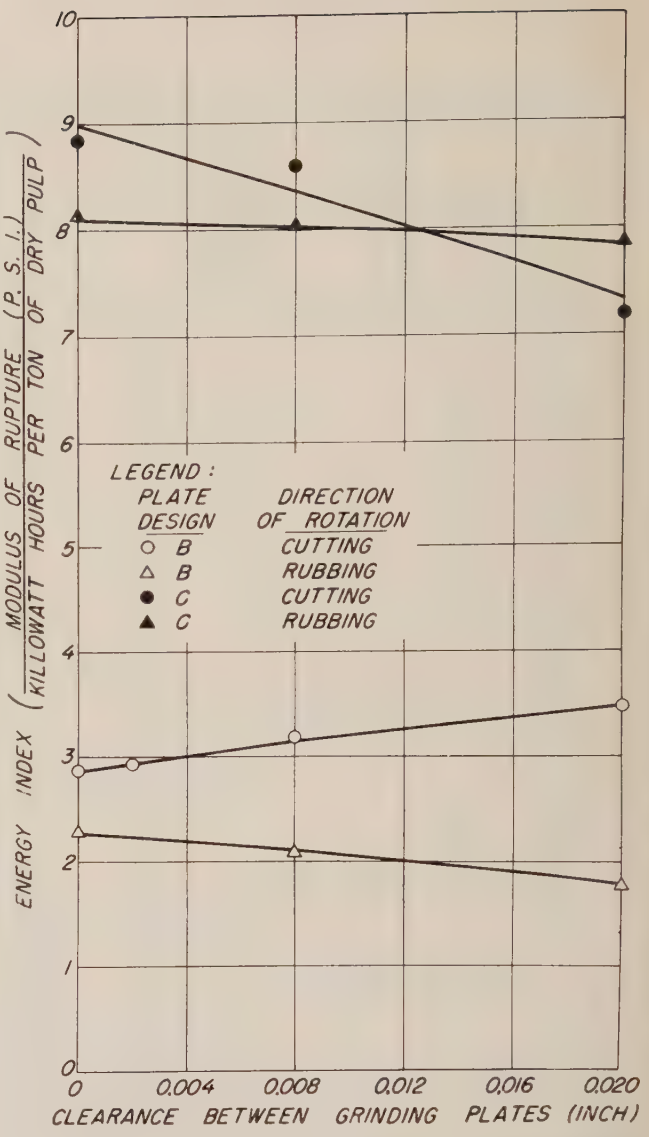

Fig. 7. Effect of plate clearance, design, and direction of rotation upon energy index

less board stock, a generally undesirable if not impractical pulp, and an acceptable stock.

Drainage quality has a vital effect upon the operational utility of a board stock, but potential sheet strength is an equally important dependent property of the pulp. In Fig. 5 comparable strength values are plotted corresponding to the conditions of plate design, direction of rotation, and clearance of Fig. 4. The observation of principal importance here is that the cutting direction produced the higher strength values in the case of plate B, but the lower strength values in the case of plate C.

The parallel strength curves for plate C are in general accordance with the corresponding drainage curves. The drainage-strength correlation ceases to hold beyond this approximation, however, since pulps with approximately equal drainage values from the same plate develop significantly different strength values. The lack of correlation is further emphasized when the effects of plate design and direction of rotation are introduced. For example, at a modulus of rupture of 6,000 p.s.i. the corresponding pulps, processed with different disks and opposite directions of rotations, had

drainage times of 40, 50, 110, and 100 sec., or a total range of almost 300%. Conversely, at drainage times in the range of 100 to 120 sec., the adjusted strength values varied from 7200 to 4400 p.s.i., a variation of nearly 50% above and below the average.

A graphical summary of observed drainage-strength relations is given in the curves of Fig. 6. The type of dispersion shown here makes a general correlation regarding drainage and strength virtually meaningless as it applies to these data.

The consistency of the energy index relation presented in Fig. 7 is a sharp contrast to the confusing drainage-strength relation. The ratio of board strength to energy consumed in milling, or the energy index, is essentially constant for a considerable range of pulp qualities processed by plates of the same design, but the index numbers obtained from plates of dissimilar designs differ by about 300%.

The curves of Fig. 7 must be interpreted with caution, because the energy index is a ratio and, in itself, does not inform about the actual level of board strength. As an example, the strongest boards (modulus of rupture, approximately 8000 p.s.i.) were derived from pulps milled with plate B, although the pulps were extremely slow draining. At a strength of 7000 p.s.i., however, plate C, in the rubbing direction, consumed about one third the energy used by plate B, while yielding a pulp having a drainage time of amost one half and equal to the pulps processed by plate B. The comparison at the strength level of 6000 p.s.i. shows that plate C yielded faster draining stock when "cutting" than when "rubbing" and, further, the pulp was about two and a half times faster draining than equal-strength pulps milled with plate B. The energy index of plate B was approximately equal in "cutting" and "rubbing" directions, but was about one third that of plate C throughout the milling conditions used in these experiments. A specific comparison is available by reference to data from lots 7 and 8, Table I, in which actual strength values and adjusted values are comparable; the drainage times differ by a factor of 3, while the ratio of index values exceeds 4 to 1.

CONCLUSIONS

The ratio of hardboard strength to energy consumed in processing the pulp is a significant measure of the effectiveness of the refining procedure. This ratio, called the energy index, is useful in evaluation of the influence of refiner-plate design on pulp quality. The energy index is essentially constant for a single plate design over a wide range of pulp quality, but dissimilar designs differ as much as 400% in their effectiveness.

The effect of plate design and direction of rotation on drainage quality is marked. In this investigation drainage time differences of as much as 300% were observed on pulps producing boards of equal strength.

The drainage test is not a reliable criterion for prediction of board strength derived from pulps processed under various conditions.

The wide range in pulp quality and effectiveness of energy utilization under various milling conditions indicates the potential benefits that may be available through intensive evaluation of pulp refining procedures.

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A Study of the Reaction Products of Lignin Model Compounds and Sodium Hydrosulphide

THOMAS G. ZENTNER

A number of lignin model compounds have been reacted with an alkaline sulphide reagent under conditions similar to the kraft cook. In addition to the guaiacyl nucleus, the compounds contained four types of functional groups: the carbonyl group, the conjugated double bond, the ether linkage, and the aliphatic hydroxyl group. Of the different functional groups, only the hydroxyl group reacted to form a sulphur derivative. Small yields of demethylated products were isolated from the experimental cooks of all model compounds containing a carbonyl group. The conjugated double bonds of three different α,β -unsaturated ketones were hydrolyzed by the action of the cooks. Cleavage of an ether linkage of one model compound was accompanied by a reducing reaction. The results point to the possibility that hydroxyl groups in lignin react during the kraft cook to form thiolignin.

Although the kraft process has been in use for many years, there is no sound explanation of the role played by the alkaline sulphide ion in the cook. One of the reactions taking place during the cook involves the chemical binding of sulphur to the lignin molecule. The introduction of sulphur may take place via one or several reactions. Various intermediate

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sulphur compounds may be formed prior to the sulphur compounds that finally exist in thiolignin. The types of sulphur linkages actually existing in thiolignin have not been definitely established. One reason for this lack of understanding is undoubtedly the complexity of lignin.

In recent years considerable attention has been directed toward the use of model compounds in studying the structure and reactions of lignin. The advantage of using model compounds lies in the fact that a known substance replaces a complicated or unknown material in reaction studies. The value of such studies depends largely upon the degree of resemblance of the model substance to the material it represents. Unfortunately, investigations with model compounds are indirect studies, and one must therefore be cautious in drawing positive analogies between reactions of models and reactions of lignin.

Although model compounds have been used extensively in studying the sulphite process, relatively little use has been made of model compounds in the study of lignin reactions during the kraft cook. The only work related to this field was carried out by Enkvist (*1*). In view of Hägglund's work (*2*) on the delignification of wood by pulping with a buffered hydrogen sulphide solution at 100° (pH 7), Enkvist studied the reactions of various model compounds using the same cooking conditions. These model compounds included eugenol, isoeugenol, veratrol, acetovanillone, vanillin, and vanillyl alcohol. Enkvist found that only vanillyl alcohol reacted significantly and in this case a 50% yield of vanillyl disulphide was obtained. He concluded that the hydroxyl groups of lignin are responsible for the formation of thiolignin. Enkvist also cooked vanillin and vanillyl alcohol with a sodium hydrosulphide liquor (pH 8.1) at 160° for 5 hr. Approximately 15% of vanillin was recovered from the vanillin cook, in addition to unidentified amorphous materials containing sulphur. The vanillyl alcohol cook yielded 10% of vanillin and other unidentified material. The formation of vanillin in the vanillyl alcohol cook was explained by an alkaline decomposition reaction of vanillyl disulphide. Enkvist recovered 45% of vanillin when vanillyl disulphide was refluxed with dilute alkali. He suggested that vanillyl disulphide was formed at 160° from vanillyl alcohol but was in turn decomposed to form vanillin, hydrogen sulphide and, possibly, vanillyl mercaptan.

PRESENTATION OF THE PROBLEM

The purpose of this investigation was to gain information concerning the reactivities of different functional groups with the alkaline sulphide ion. An examination of previous lignin investigations indicated that four types of functional groups were of particular interest. These were the hydroxyl group, the carbonyl group, the ether linkage, and the "masked" conjugated double bond similar to that suggested by Wacek and Kratzl (*3*); based on these groupings, four mechanisms for the introduction of sulphur into the lignin molecule were postulated.

1. A hydroxyl group may react by splitting out water.

$$ROH + NaSH \rightarrow RSNa + H_2O$$

2. A carbonyl group may react to form a hydrated thione.

$$RRCO + NaSH \rightarrow RRC(OH)(SNa)$$

3. Ether linkages may be split with the introduction of sulphur.

$$R—O—R + NaSH \rightarrow ROH + RSNa$$

4. Masked conjugated double bonds may be liberated and react.

$$—COCH=CH— + NaSH \rightarrow —COCH_2CHSNa—$$

The problem then involved the selection and synthesis of different lignin model compounds containing the desired functional groupings. The compounds were subjected to the action of the alkaline sulphide ion under conditions similar to those of the kraft cook. The products were isolated and identified, and when possible the course of the reaction was described. Special attention was directed toward those model compounds which combined with sulphur.

MODEL COMPOUNDS

The model compounds studied in this investigation were propiovanillone (I), 2′4-dihydroxy-3-methoxychalcone (II), 4,4′-dihydroxy-3,3′-dimethoxychalcone (III), 4′ - hydroxy-3′ - methoxyflavanone (IV), 2-vanillylidene-3-coumaronone (V), vanillin (VI), ω-(4-acetyl - 2 - methoxyphenoxy)acetovanillone (VII), and 1-(4-hydroxy-3-methoxyphenyl)-1-propanol (VIII) (see Table I for formulas).

Two model compounds, 4′ - hydroxy - 3′ - methoxyflavanone and 2-vanillylidene-3-coumaranone were obtained from B. Sen (*4*). Vanillin was a commercial product. The other compounds were prepared according to procedures given in the literature.

SODIUM HYDROSULPHIDE COOKS

The experimental procedures for studying the reactions of one model compound are given. The original dissertation (*5*) should be consulted for additional experimental details. All temperatures are in degrees centigrade and are uncorrected.

Since the primary purpose of this investigation was to gain an insight into the formation of thiolignin, it seemed advantageous to accentuate as far as possible the role of the sulphide ion in the cooking liquor. The use of a regular kraft cooking liquor was not suitable because the action of the alkali in great excess would overshadow the action of the sulphide ion. On the other hand, hydrogen sulphide was not desirable because of the vast differences between acid and alkaline cooking liquors. A sodium hydrosulphide solution appeared to serve most satisfactorily as a cooking liquor. However, the neutral or near neutral sodium hydrosulphide solution (pH, 7.0 or 8.1) used by Enkvist (*1*) was not considered sufficiently alkaline to represent the actions of the reagent in the kraft cook.

Two cooking liquors were prepared for the experimental cooks. Liquor A contained 1.66 moles of sulphur per liter (as sulphide and hydrosulphide, determined by titration with standard iodine solution) and 1.76 moles of sodium per liter (determined by titration with standard hydrochloric acid to a methyl orange end point); the pH was 12.3 at 22°. Liquor B contained 1.30 moles

of sulphur per liter and 1.75 moles of sodium per liter; the pH was 12.9 at 22°.

During the initial experimental cooks it was learned that sodium hydrosulphide solution A would not always completely dissolve the model compounds. When the cook was carried out with part of the compound undissolved, a residue formed that was very resinous and could not be characterized. On the other hand, no insoluble residues formed when the more alkaline liquor (B) was used.

In order to compare the effects of using either liquor A or B, the cooks with 2′,4-dihydroxy-3-methoxychalcone can serve as an example. Approximately 150 ml. of liquor A were required to dissolve 2.0 grams of the chalcone, whereas 4.0 grams of the compound were easily dissolved in 80 ml. of cooking liquor B. A residue did not form in either cook and the yields of vanillin were approximately the same. When 8.0 grams of the chalcone were cooked with 240 ml. of cooking liquor A, it was only partially dissolved and a gummy residue formed.

Because of the ease of polymerizing phenolic materials, especially when heated in a solid state, it was decided that the more alkaline liquor B, which kept the phenolic compounds in solution, was preferred. Therefore, instead of using a sodium hydrosulphide liquor (solution A), a liquor was chosen that contained 1 mole of sodium sulphide to 2 moles of sodium hydrosulphide (solution B).

GENERAL PROCEDURES

Cooking Procedure

A 300-ml. stainless steel autoclave was used for all cooks. It was equipped with a pressure gage, a thermometer, and a valve for relieving gases. The autoclave fitted snuggly into a Glascol heating mantle (600-ml. beaker size). The entire unit was mounted on a shaker to insure continuous mixing.

The model compounds were cooked 4 to 5 hr. at 160°. Approximately 2 hr. were required to reach maximum temperature and the autoclave was allowed to cool overnight after the cooking period. Gases were relieved from the autoclave at 105°.

Isolation of Reaction Products

The contents of the autoclave were transferred to a separatory funnel and saturated with sodium chloride and hydrogen sulphide. The neutral solution was then extracted with ether three times. The ether extract was washed with water, dried over sodium sulphate, and evaporated under vacuum.

The reaction products obtained by using the above procedure were not contaminated with free sulphur. When hydrochloric acid or carbon dioxide was used to neutralize the alkaline liquor, considerable free sulphur was present with the isolated products. Evidently sulphur was soluble in the solution neutralized with hydrogen sulphide and was not extracted in appreciable quantities by the ether.

Chromatographic Separations of the Reaction Products

In several cases the isolated reaction products were separated by using chromatographic techniques. The procedure involved chromatographing a benzene solution of the product mixture on an acid-washed Magnesol column (*6*). A benzene-absolute ethanol solution was used as a developer. After extrusion, the column was streaked with the following streak reagents (*6*): ferric chloride, 2,4-dinitrophenylhydrazine, and alkaline potassium permanganate. The different zones indicated by the streaking reagents were separated and eluted with acetone.

Prior to carrying out a full-scale chromatographic separation of the entire mixture, it was necessary to run several preliminary chromatograms in order to establish developing conditions. The preliminary chromatograms were run on an 11 by 130-mm. column, using 10 to 20 mg. of the product mixture and one column length of 100:1 benzene-absolute ethanol as a developer. (The amount of developer necessary to completely wet the packed column was considered one column length of developer.) Depending upon the type of separations obtained on an 11 by 130-mm. column, the developing conditions were modified by changing the ratio of benzene to absolute ethanol and/or by varying the amount of developer used.

2′,4-DIHYDROXY-3-METHOXYCHALCONE

2′,4-Dihydroxy-3-methoxychalcone (4.0 grams) was cooked in 80 ml. of cooking liquor B for 4.5 hr. at 160°. By using the general procedure, approximately 4.0 grams of partially crystallized oil were obtained. The product did not have a typical kraft odor.

A benzene solution of the product was chromatographed on a 48 by 270-mm. column using 1.5 column lengths of 200:1 benzene-absolute ethanol developer. After extruding the column and streaking, the zones listed below were obtained.

The material from zone B was a dark, partially crystallized oil. The crystals melted at 139 to 149° (Fischer-Johns melting point apparatus). The material after recrystallizing from xylene melted at 145 to 150°. A second crystallization from water gave a light-colored product melting at 148 to 153°. This crystalline material was then boiled in ethanol with decolorizing carbon and, after filtering, the alcohol was evaporated to yield a white product melting at 147 to 151°.

Zone	*Streaking results*	*Recovered material* *Grams*	*%*
A	Dark colored	0	...
B	Green ferric chloride Brown 2,4-DPH[a]	0.20	5.0
C	Yellow colored	0.20	5.0
D	Orange 2,4-DPH[a]	1.60	40.0
E	Yellow colored	0.40	10.0
F	Violet ferric chloride	1.40	35.0
		3.80	95.0

[a] 2,4-dinitrophenylhydrazine.

Recrystallizing this product from benzene produced crystals that melted at 151 to 153° and gave no depression in a mixed melting point with an authentic sample of protocatechualdehyde (m.p. 151 to 153°). The product also gave a strong green color with ferric chloride.

Zone D yielded a light yellow crystalline material melting at 71 to 77°. The material was recrystallized from petroleum ether (60 to 110°) to yield 1.2 grams of fluffy needles melting at 78 to 80°. A mixed melting point with vanillin gave no depression. A small amount

of yellow oil, insoluble in the boiling petroleum ether, was combined with the material from zone E. An ether solution of the combined material was extracted with 21% sodium bisulphite solution and then evaporated. The resulting yellow crystalline material (0.3 gram) melted at 110 to 124°. Recrystallization from dilute ethanol yielded yellow needles that melted at 125 to 127° and gave no depression in a mixed melting point with 2′,4-dihydroxy-3-methoxychalcone.

A paper chromatogram, using butanol saturated with 2% ammonia as a developer, indicated that the material in zone C was mainly vanillin with a small amount of the unreacted chalcone.

The oil obtained from zone F had the odor of *o*-hydroxyacetophenone. The acetate was prepared by dissolving the oil in pyridine, adding an excess of acetic anhydride, and allowing the solution to react overnight. A solid product was obtained when the solution was poured into ice water. The crude acetate (1.1 grams) melted at 80 to 86°. Recrystallizing from dilute ethanol yielded crystals melting at 87 to 88.5°. A mixed melting point with an authentic sample of *o*-acetoxyacetophenone gave no depression.

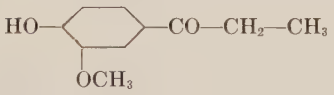
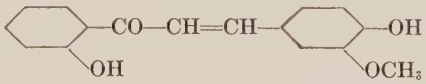
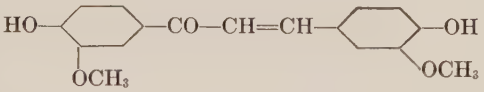
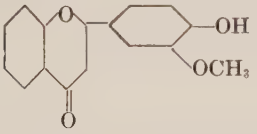
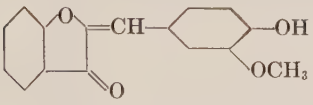
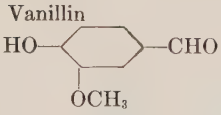
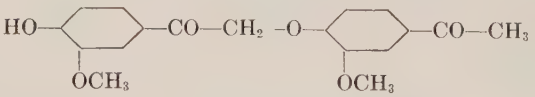
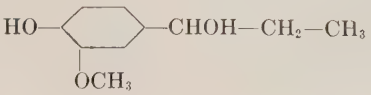
DISCUSSION

Model compounds containing four types of functional groups were studied in the sodium hydrosulphide cooking experiments. The functional groups included the carbonyl group, the conjugated double bond, the ether linkage, and the aliphatic hydroxyl group. The products isolated and identified from the different model compounds are listed in Table I.

Compounds containing the carbonyl group did not react to form sulphur derivatives. Propiovanillone was very resistant to the action of sodium hydrosulphide. After cooking 4 hr. at 160°, approximately 80% of the propiovanillone was recovered unchanged. A small amount of 4-propionylpyrocatechol (demethylated propiovanillone) was also obtained. Cooking propiovanillone for 30 hr. at 160° increased the demethylation (15 to 20% yield of 4-propionylpyrocatechol) but 65 to 70% of the propiovanillone was recovered unchanged.

The action of sodium hydrosulphide on a conjugated double bond was studied by cooking substituted chalcones. The chalcones were 2′,4-dihydroxy-3-methoxychalcone and 4,4′-dihydroxy-3,3′-dimethoxychalcone.

Table I. Model Compounds and Their Products

	Model compounds	*Products*
I	Propiovanillone 	Propiovanillone 4-Propionylpyrocatechol
II	2′,4-Dihydroxy-3-methoxychalcone 	Vanillin *o*-Hydroxyacetophenone Protocatechualdehyde 2′,4-Dihydroxy-3-methoxychalcone
III	4,4′-Dihydroxy-3,3′-dimethoxychalcone 	Vanillin Acetovanillone 4,4′-Dihydroxy-3,3′-dimethoxychalcone
IV	4′-Hydroxy-3′-methoxyflavanone 	Vanillin *o*-Hydroxyacetophenone 2′,4-Dihydroxy-3-methoxychalcone
V	2-Vanillylidene-3-coumaranone 	Vanillin Protocatechualdehyde 2-Vanillylidene-3-coumaranone
VI	Vanillin 	Vanillin Protocatechualdehyde
VII	ω-(4-Acetyl-2-methoxyphenoxy)acetovanillone 	Acetovanillone
VIII	1-(4-Hydroxy-3-methoxyphenyl)-1-propanol 	Bis[1-(4-hydroxy-3-methoxyphenyl)-1-propyl]disulphide Isoeugenol Diisoeugenol

The reaction of another model compound containing a conjugated double bond, 2-vanillylidene-3-coumaranone, was also studied.

The alkaline sulphide reagent appeared to have the same effect upon all α,β-unsaturated ketones studied. In each case a reverse aldol reaction occurred and the corresponding ketones and aldehydes were formed.

Four products were isolated from the 2′,4-dihydroxy-3-methoxychalcone cook to account for over 90% of the starting material. Vanillin and *o*-hydroxyacetophenone were the main products and small amounts of the unreacted chalcone and protocatechualdehyde (demethylated vanillin) were obtained.

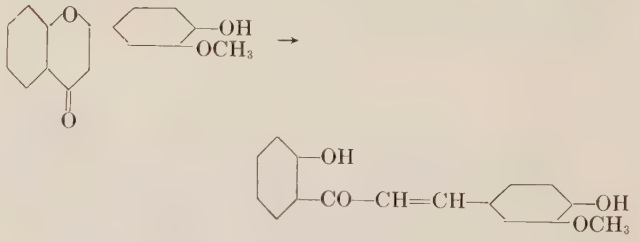
Vanillin and acetovanillone were the main products obtained from cooking 4,4′-dihydroxy-3,3′-dimethoxychalcone. (These products accounted for over 75% of the starting material.) A small quantity of the unreacted chalcone was recovered and demethylated products were indicated by chromatograms, although none was isolated and identified as such.

The reaction products of 2-vanillylidene-3-coumaranone were not completely accounted for. The isolation of protocatechualdehyde and approximately 80% of the theoretical amount of vanillin indicated that a reverse aldol reaction occurred. However, coumaranone, which would be the other component of the reverse aldol reaction, was not obtained. Instead, mixtures of high melting solids and viscous oily products were obtained. Evidently coumaranone underwent autocondensation under the alkaline conditions. The fact that these complex products were not soluble in alkali indicated that the heterocyclic ring was not broken. (Otherwise, a free phenolic group would have been liberated.) The possibility that coumaranone formed condensation products was indicated by studies of Fries and Pfaffendorf (*7*). They found that coumaranone could be condensed under different alkaline conditions to form a variety of products. Some of the products were identified as dimers but other products were reported as high melting solids and viscous oils.

Protocatechualdehyde was isolated from each of the cooks in which vanillin was a product. In previous investigations of lignin degradation products where vanillin was isolated, the presence of protocatechualdehyde was not reported. This suggested the possibility that demethylation occurred prior to formation of vanillin in the reverse aldol reaction. However, the fact that protocatechualdehyde (2 to 3% yield) was isolated from the vanillin cook proves that vanillin itself can be demethylated under the cooking conditions used. Approximately 75% of the vanillin was recovered unchanged. The high yield of vanillin indicated a marked difference in the cooking liquor employed in this investigation and that used by Enkvist (*1*). Enkvist cooked vanillin with a sodium hydrosulphide solution (pH 8.1) at 160° for 5 hr., and recovered only 15% of the vanillin. The other products were amorphous and contained sulphur.

Recently, Jayne (*8*) carried out an alkaline nitrobenzene oxidation of vanillin at 160°; among other products, a small amount of protocatechualdehyde was indicated by paper and column chromatograms. This implies that demethylation is not specific to the action of the alkaline sulphide reagent. Indeed, it seems likely that demethylated products were formed in the previous investigations, but these products were not isolated and identified because suitable techniques were not available for isolating such small amounts of material. It is felt that, when the more sensitive techniques, such as chromatography, are employed to study lignin degradation products, the isolation of demethylated products will become more common.

The model compound 4′-hydroxy-3′-methoxyflavanone contains a "masked" conjugated double bond. Splitting the heterocyclic ring could cause the formation of 2′,4-dihydroxy-3-methoxychalcone. Evidently when 4′-hydroxy-3′-methoxyflavanone was subjected to the action of the sodium hydrosulphide cook, the initial reaction involved the formation of the corresponding chalcone. The products of the cook were identical with those obtained from cooking 2,4-dihydroxy-3-methoxychalcone—i.e., vanillin and *o*-hydroxyacetophenone were the main products and small amounts of protocatechualdehyde and 2′,4-dihydroxy-3-methoxychalcone were obtained. If unreacted 4′-hydroxy-3′-methoxyflavanone was present in the product, it was in such a small quantity that it could not be detected by paper chromatograms.

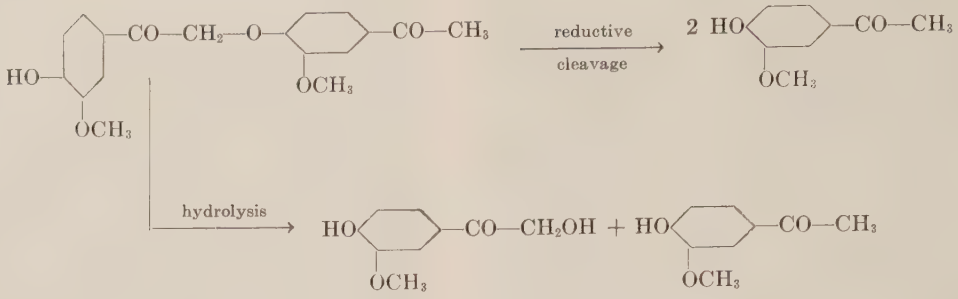


The action of the alkaline sulphide reagent on an ether linkage, other than the methoxyl group, was studied by cooking ω-(4-acetyl-2-methoxyphenoxy) acetovanillone. Hydrolysis of the ether linkage should form two products, ω-hydroxyacetovanillone and acetovanillone. If reductive cleavage took place, only acetovanillone should form. A study of the cooking products indicated that the ether linkage was split by a reducing reaction; acetovanillone was isolated in sufficient quantity to account for approximately 70% of the starting material. A mixture of other products (about 20%) was also obtained. Chromatograms indicated that the mixture contained four or five different materials, of which the starting material was the chief component. A small amount of demethylated material, possibly 4-acetylpyrocatechol, was also indicated by chromatograms.

The reactivity of the aliphatic hydroxyl group with sodium hydrosulphide was studied by cooking 1-(4-hydroxy-3-methoxyphenyl)-1-propanol. The results indicated that the compound was very reactive toward sodium hydrosulphide. Cooking at 160° produced a product that could not be identified. In the following table, the elementary analysis of the reaction product is compared with the elementary composition of the starting material and that of isoeugenol (or its polymerization products).

The molecular weight data indicated that 1-(4-hydroxy-3-methoxyphenyl)-1-propanol polymerized during the cook. The loss of oxygen and the increase in the carbon content pointed to the possibility that dehydration had occurred. The ease with which 1-(4-hydroxy-

3-methoxyphenyl)-1-propanol was dehydrated was shown by the formation of isoeugenol on distillation.



Attempts to distill the reaction product failed to produce a pure product. A fraction distilling from 150 to 260° at 0.3 mm. pressure had a molecular weight (Rast) of 215. The molecular weight of the distillation residue was 715. Evidently, the polymerized product was partially fractionated by distillation. Additional polymerization could have occurred during the distillation. Because of the apparent complexity of the reaction during cooking, an extended study of 1-(4-hydroxy-3-methoxyphenyl)-1-propanol under different reaction conditions was carried out.

	Model compound	*Reaction product*	*Isoeugenol, diisoeugenol, or polymeric derivatives*
C, %	65.8	68.0	73.1
H, %	7.7	7.8	7.3
O (by difference), %	26.5	23.8[a]	19.4
Mol. wt.	182	360[b]	...

[a] Product also contained 0.4% sulphur.
[b] Rast molecular weight.

1-(4-Hydroxy-3-methoxyphenyl)-1-propanol reacted with sodium hydrosulphide at room temperature to form bis[1-(4-hydroxy-3-methoxyphenyl)-1-propyl]disulphide. The reaction took place in aqueous or alcoholic solutions. It was noted that the formation of the disulphide depended upon the presence of air. Evidently, the mercaptan was formed as an intermediate. The oxidation of mercaptans in alkaline solution by air is a well-known reaction.

Besides obtaining the disulphide from the room temperature reaction, an oily product was also obtained. When the oily material was treated with mercuric acetate in acetic acid, diisoeugenol was isolated. Diisoeugenol could not be obtained by treating 1-(4-hydroxy-3-methoxyphenyl)-1-propanol with mercuric acetate. The mechanism for the formation of diisoeugenol could not be determined. However, the formation of diisoeugenol indicates that the side chain may be involved in the polymerizing reactions of the model compound.

When 1-(4-hydroxy-3-methoxyphenyl)-1-propanol was cooked with sodium hydrosulphide at 100° for 6 hr., a product was obtained that contained 5.2% sulphur. The product was treated with mercury prior to analysis to insure the complete removal of free sulphur. In addition to removing free sulphur, mercury was shown to react slowly with chemically bound sulphur. Therefore, the sulphur contents of the products treated with mercury may be slightly low.

Because the regular 160° reaction product contained a very slight amount of sulphur, it seemed likely that sulphur was removed from the product at the high temperature. This was further shown by a comparison of two reaction products. The first product was formed by reacting the model compound with sodium hydrosulphide at 85° for 16 hr. The product contained 5.2% sulphur and its molecular weight (Rast) was 290. The second product was obtained from a two-stage reaction: the first stage involved a reaction for 16 hr. at 85° and the second stage involved a reaction for 2 hr. at 160°. The sulphur content of the second product was 0.4% and its molecular weight (Rast) was 880. A comparison of the products from the two experiments indicated that the high temperature not only decomposed the sulphur compound but also caused polymerization.

1-(4-Hydroxy-3-methoxyphenyl)-1-propanol was also reacted with a neutral sulphide solution at 100° for 72 hr. Enkvist (*1*) obtained vanillyl disulphide from vanillyl alcohol under such conditions. Isoeugenol (20% yield) was the only product identified from the reaction of 1-(4-hydroxy-3-methoxyphenyl)-1-propanol. Evidently, heating the undissolved model compound was more conducive to dehydration than to the formation of a sulphur derivative.

Although the pH of the cooking liquor employed by Enkvist (*1*) was much lower than that used in the present investigation, two similarities were noted in the reactions of the hydroxyl grouping. Under mild conditions both vanillyl alcohol and 1-(4-hydroxy-3-methoxyphenyl)-1-propanol reacted to form disulphides and at 160° the disulphides were not obtained. In fact, nonsulphur-containing products were obtained from the 160° cooks; vanillin was a product of vanillyl alcohol and an unidentified nonsulphur-containing polymer was a product of 1-(4-hydroxy-3-methoxyphenyl)-1-propanol.

It would be extremely unwise to interpret all the reactions of lignin during the kraft cook on the basis of reactions of a few model compounds. However, the results of the model compound cooking experiments do point out certain reactive groups as well as nonreactive groups. For example, the results indicate the improbability of a carbonyl group reacting to form a sulphur derivative during the kraft cook. Although α,β-unsaturated ketones are readily sulphonated, it is doubtful whether a similar reaction can take place with the sulphide ion in the kraft cook. A reverse aldol reaction hydrolyzes such groups before an addition reaction is possible.

A similarity was noted in the room temperature reactions of 1-(4-hydroxy-3-methoxyphenyl)-1-propanol and of native lignin. Both materials reacted to form sulphur derivatives. Indeed, of the different functional groups studied, only the hydroxyl group was noted to

react with the alkaline sulphide ion to form a sulphur derivative. The instability of the sulphur derivatives at higher temperatures is not wholly different from that of thiolignin. Thus, Ahlm (*9*) found that the sulphur in thiolignin was readily split off in the presence of alkali. (Approximately one half of the sulphur was lost when Ahlm methylated thiolignin with dimethyl sulphate and sodium hydroxide.) These results definitely point to the possibility of hydroxyl groups in lignin being responsible for the addition of sulphur during the kraft cook.

An interesting observation with respect to kraft odors was noted in the model compound cooks. Although all cooks had a slight kraft odor, only the 1-(4-hydroxy-3-methoxyphenyl)-1-propanol cook had the strong garlic odor. In view of the fact that demethylation occurred in the other cooks, the mild odors of the cooks indicate that methyl mercaptan or methyl disulphide was not formed during demethylation reactions. There has been considerable speculation on this subject in the past, and many investigators have ascribed the formation of kraft odors (methyl mercaptan, etc.) to the demethylation reaction of lignin. If the ether cleavage of ω-(4-acetyl-2-methoxyphenoxy)acetovanillone is typical for the kraft cook, then demethylation of lignin should produce methane rather than methyl mercaptan. A hydrolytic cleavage of the methoxyl group would cause the formation of methyl alcohol. The mechanism of the demethylation was established in this investigation.

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Thermal Conductivity of Paper Honeycomb Cores and Sound Absorption of Sandwich Panels

D. J. FAHEY, M. E. DUNLAP, and R. J. SEIDL

This paper presents results of research work on thermal conductivity of paper honeycomb cores and ways of improving their insulation value. In addition, there are data on sound absorption of sandwich panels having solid and perforated facings. The thermal insulation values of a honeycomb core depended on the type of construction and its density. Filling the cells with foamed-in-place resin or with fill materials resulted in some improvement in the thermal insulation value. The lowest value obtained compared favorably with that of common mineral wood products. Sandwich panels faced with hard facings, such as hardboard, had relatively no sound absorption properties. Incorporating artificial perforations in one facing similar to those in ordinary acoustical tile, however, resulted in an appreciable increase in the amount of sound the panel absorbed. Utilizing the natural holes in white-pocket Douglas-fir veneer was also effective in increasing the acoustical value of the panel. Although the sandwich panels with perforated facings absorbed an appreciable amount of sound, the average sound absorption coefficient was lower than the coefficient obtained on some of the common acoustical materials.

Paper honeycomb assemblies in one form or another are becoming more and more important as core materials in sandwich-type building panels. Light, strong, and stiff panels can be produced by bonding facings of plywood, hardboard, aluminum, or other sheet material to such lightweight core materials.

Research work on sandwich construction has been carried on at the Forest Products Laboratory for over 10 years. The early work was devoted to the development of high-strength, lightweight sandwich materials suitable for aircraft application, and the determination of their engineering properties. After World War II, because of the increasing demand for building materials, the principles learned in investigations of aircraft materials were modified to produce panels suitable for building purposes. For such applications thermal insulation and durability became more important and strength requirements perhaps lessened. After considerable experimentation, a sandwich panel test unit was erected on the Laboratory premises as a means of obtaining information on the performance of sandwich constructions upon outdoor exposure (*4*). Since its erection additional information has been obtained on the strength, bowing, durability, thermal insulation value, and fire resistance of sandwich constructions (*1*, *2*).

It was apparent early in the work on paper honeycomb cores that, if they were to be used in panels where any great degree of thermal insulation was needed, it would be desirable to fill the cells of the honeycomb. In 1944 a few exploratory attempts were made to fill the cells of the honeycomb, and a phenolic resin was successfully formed into the honeycomb structures. Cores

D. J. Fahey, Technologist, M. E. Dunlap, Engineer, and R. J. Seidl, Chemical Engineer, Forest Products Laboratory, Forest Service, U. S. Dept. of Agriculture, maintained at Madison, Wis., in cooperation with the University of Wisconsin.

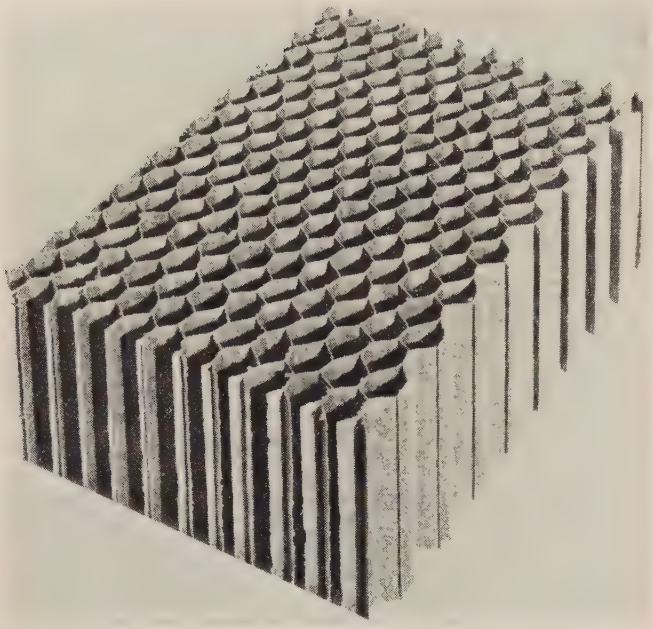
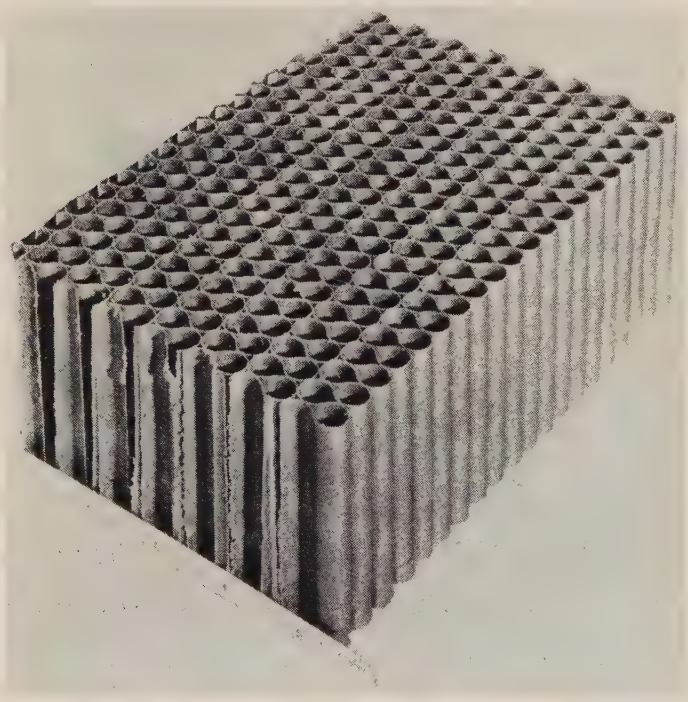


Fig. 1. Top, expanded type of paper honeycomb core; bottom, figure-8 type of paper honeycomb core



were forced into blocks of balsa wood with little difficulty. These few experiments indicated the possibility of filling the air spaces of the honeycomb structure when improved insulation properties are needed.

To use sandwich construction in buildings erected in cold northern climates it appears to be necessary to fill the cells to obtain insulation properties equivalent to those of conventional insulated construction. In some cases increasing the thickness of the core material between the facings may be the most economical way of improving insulation properties; in other cases it may not be practical.

When sandwich construction was first considered for building material in partitions and doors, its ability to absorb or transmit sound was often questioned. Most of these panels would have very little inherent sound-absorbing properties because of the hard-surfaced facings and the low mass of the panels. These properties might be improved, however, by means of perforations in one of the exposed faces or by special core constructions.

This report summarizes investigations of (1) ways of improving the thermal insulating properties of the cores by filling the openings with low density foam or fill materials and (2) sound absorption properties of sandwich construction as affected by the core and the facings.

MATERIALS

Honeycomb Core

Paper can be converted to honeycomb core in a number of different ways. The expanded type is made by interspacing sheets of treated paper with parallel and uniformly spaced strips of adhesive and expanding the assembly, after bonding, to form a core with hexagonal cell sections (Fig. 1, top). Another type is made by looping and bonding sheets of resin-treated paper to form circular cells representing a "figure 8" in cross section (Fig. 1, bottom). From assemblies of sheets of corrugated paper, a number of different core constructions are also possible, some easier than others to fabricate. Eight such constructions are shown in Fig. 2. Most of the experiments reported herein were made with the corrugated core.

A kraft paper weighing 20, 30, or 50 lb. per 3000 sq. ft. was treated with 15% of a water-soluble phenolic resin (based on the total weight of resin and fiber). The paper was corrugated on A-flute corrugating rolls (approximately 3 flutes per in.) and assembled into blocks with a phenolic adhesive. In some cases a flat sheet of treated paper was inserted between the corrugated sheets.

Filling the Cells of the Honeycomb

There are a number of different ways of filling the opening of the cells, including foaming resin into the cells, filling cells with finely granulated insulating material, or forcing the core into blocks of low density material. In these experiments three phenolic foaming-type resins were tried, using procedures recommended by the manufacturer except for slight modifications for producing the foamed-in-place resin. All three were liquid resins, and with the addition of a catalyst, and in one case heat, they could be formed into the honeycomb cells.

Resin A required no heat to produce the foaming action. Aerating the liquid resin with a high-speed mechanical stirrer for about 1 min. alone tended to increase

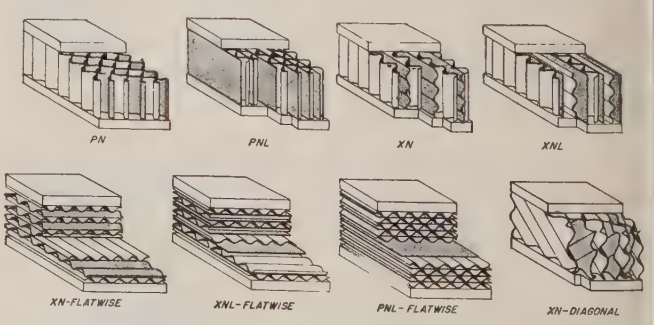


Fig. 2. Various types of corrugated-paper honeycomb cores

the volume by about 10 to 20%. About 5% of an acid-catalyst solution based on the weight of liquid resin was added to the resin and mixed thoroughly for a few seconds. The mixture was rapidly poured into a shallow container, and the core was immediately placed in the layer of resin and held there, with no external heat required, until the foaming was completed. The foam was sufficiently set after a few minutes to permit removal of the core from the form (Fig. 3). Since a large amount of heat was generated, it was necessary to allow for rapid removal of the gas that evolved during the reaction. The foamed resin was spongelike in structure and pink in color when produced, but it darkened slightly in time.

The walls of the honeycomb cells offered a resistance to the foaming action of the resin. If the resin was foamed into a large block with no core to obstruct the foaming action, a foam with a density of 0.3 lb. per cu. ft. or less was obtained, but the lowest density foam produced in a corrugated-type honeycomb structure was about 1 lb. per cu. ft. The density of the foamed resin in a figure-8 type of core with loops about $1^1/_4$ in. in diameter was about one-third that in a corrugated honeycomb structure with cells about $^1/_4$ in. in diameter. Warming the honeycomb core before foaming the resin into the cells facilitated the rate of the reaction and resulted in lower density foams.

The foaming procedure for the second phenolic resin, resin B, was about the same as that for resin A, except that this resin required the addition of two ingredients before the activator. When the activator was added, the original brown resin color changed to green. This change was an indicator of the approximate time in which the foaming action would occur.

The third foaming resin, resin C, required a temperature of 350°F. to produce the foaming action. About 6% of a powdered catalyst was mixed with the resin, the mixture was poured into a shallow container, and the core was held firmly down on the resin. Both the container and the core were placed in a circulating oven for 15 min. which was the approximate time required to complete the reaction.

In the few preliminary experiments on the three resins, resin A produced the lowest density foam for a given core construction. All three foams had low water

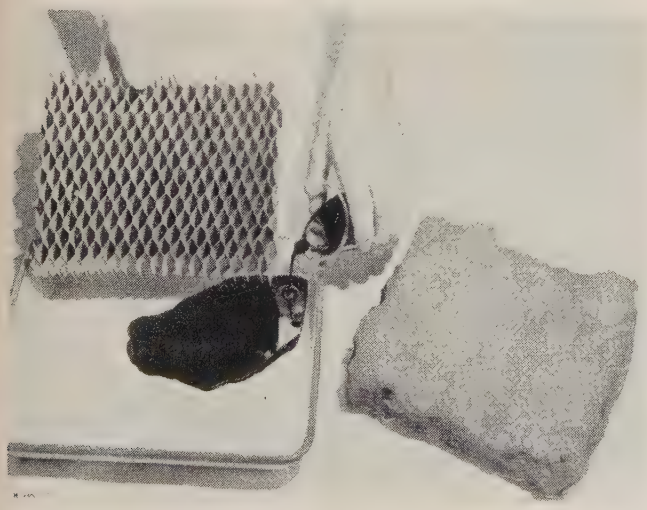


Fig. 3. Left, resin in container before foaming in the core; right, block of core with foamed-in-place resin

Table I. Thermal Conductivity of Honeycomb Cores with No Fill Insulation

Type of honeycomb core[a]	*Weight of paper, lb./3000 sq ft.*	*Weight of core, lb./cu. ft.*	*Mean temperature, °F.*	*Conductivity value k, B.t.u./sq. ft./hr./in./°F.*
Corrugated-PN	50	2.94	75.1	0.47
Corrugated-PNL	50	5.49	77.2	0.59
Corrugated-XN	50	2.75	78.6	0.45
Corrugated-XNL	50	5.30	76.4	0.51
Corrugated-XN flatwise	50	2.75	74.9	0.36
Corrugated-XNL flatwise	50	4.68	75.5	0.29
Corrugated-PNL flatwise	50	4.25	75.5	0.31
Corrugated-XN diagonal	50	2.69	76.9	0.48
Corrugated-PNL Figure 8	30	3.35	76.8	0.47
	..	2.89	76.0	0.53

[a] For the corrugated core arrangements see Fig. 2.

absorption. In addition to improvement of thermal insulation, an improvement in the fire resistance of the panel can be realized with foamed-in-place resins. The combustibility of a panel should also be lessened. Depending on the density of the foam, an improvement in compressive strength of the core has also been obtained.

In large-scale production of resin-filled core it may be possible to spot droplets of catalyzed resin on a rapidly moving corrugated web that is in the process of being assembled into core, or to deposit droplets of catalyzed resin into cells of the assembled core, so that with proper timing the foam would fill the cells and provide the inherent benefits.

Three commercial, relatively low density, granulated fill materials were investigated to determine their effect on improving the insulating value of honeycomb core. The following were tried: (a) silica aerogel fill insulation, (b) shredded urea-formaldehyde foam, and (c) siliceous volcanic rock material heated to make it expand to a light and fluffy mass. Test panels of honeycomb core, 14 by 14 in. in area and 1 in. thick, were prepared. A thin kraft paper was bonded to one surface of the panel to hold the fill material in the cells. The various fill materials were then sifted into the openings from the other surface. The cores were vibrated slightly to facilitate filling the cells. The puffed siliceous material was more granular than the other two fill materials and seemed to fill the cells with the least vibrating. After the cells were filled, a similar kraft paper was bonded to the other surface.

A few laboratory attempts to fill 8-ft.-long sections of complete sandwich panels having a certain type of corrugated core demonstrated that it would be feasible to fill commercial-size panels after the facings have been bonded to the core. A panel with the core having one half of the flutes parallel to the 8-ft. length and the remaining flutes perpendicular to the facings was used for these trials. With the higher density granular materials no particular difficulty was experienced in filling the panel by permitting the granules to sift down the 8 ft. of open path. With the lower density material (pulverized urea foam) the first attempts were unsuccessful, but the panel was finally filled by placing it against a vibrator as the fill material was added.

Since lower density foams could be obtained by foaming resin into large blocks (without the core) than

Table II. Effect of Foamed Resin and Fill Insulation on Thermal Properties of Honeycomb Cores

Type of honeycomb core	*Added insulation*	*Weight per cu. ft., lb.*	*Mean temperature, °F.*	*Conductivity value k, B.t.u./sq. ft./hr./in./°F.*
	Foamed-in-Place Resin			
Corrugated-PN	None	3.48	77.9	0.58
Corrugated-PN	Foamed resin A	5.33	77.0	0.40
Corrugated-PN	Foamed resin B	8.70	78.3	0.41
Corrugated-PN	Foamed resin C	10.52	78.1	0.51
Figure 8	None	2.89	76.0	0.53
Figure 8	Foamed resin A	5.50	77.6	0.38
Figure 8[a]	Foamed resin A	1.88	77.7	0.31
	Fill Insulation			
Corrugated-PN	None	3.48	77.9	0.58
Corrugated-PN	Shredded urea foam	4.72	77.3	0.37
Corrugated-PN	Silica aerogel	6.44	77.5	0.35
Corrugated-PN	Puffed siliceous rock	10.68	78.1	0.45
Corrugated-XN	None	2.75	78.6	0.45
Corrugated-XN	Shredded urea foam	4.08	76.3	0.35
Corrugated-PNL flatwise	None	4.68	74.9	0.31
Corrugated-PNL flatwise	Silica aerogel	8.47	77.5	0.27

[a] Large loops 1 1/4 in. in diameter made with 20-lb. kraft paper.

by foaming in place in a honeycomb structure, attempts were made to force the core into preformed blocks of the low density phenolic foam. This practice was unsuccessful with these three phenolic foams because of their spongy nature. A foamed polystyrene, balsa wood, and foamed rubber materials, however, were successfully forced into small samples of core.

Panels for Sound Absorption Tests

Eight sandwich panels, with various arrangements of the corrugated type of core, were prepared for sound absorption tests. Details as to type of core arrangement and facings for the different test panels were given in Table III. The core in all panels was made from 50-lb. paper with 15% of resin. Since perforated surfaces are known to favor sound absorption, panels with hardboard facings were tested with and without perforations. The perforations were made by drilling 3/16-in.-diameter holes about 5/16 in. apart in one of the facings; no holes were drilled in the other facing. The perforated facing contained approximately 510 holes per sq. ft. An aluminum-faced panel with one facing perforated in the same manner was also tested. The natural holes in white-pocket Douglas-fir veneer were also utilized in two test panels. Veneer 1/16-in. thick that was cut from heavy-white-pocket wood had numerous holes and pockets. This veneer was bonded to one side of a panel, and the other facing was made from light-white-pocket Douglas-fir veneer with practically no holes.

In sandwich panels for structural application the core is usually placed in the panel with part or all of the flutes of the corrugated sheet perpendicular to the facing, leaving direct channels from one facing to the other. It was thought that if such cores were placed with flutes on a diagonal to the facings, the sound waves entering the panel would be deflected by the walls of cells, and the sound absorbing properties of the panel would be improved. Three panels were thus prepared for test in which the core was placed with flutes running at a 45° angle instead of 90° to the facing.

The cores were bonded to the hardboard and veneer facings with an acid-catalyzed, high-temperature-setting phenolic resin adhesive. The resin was applied to both the facings and the core, and the panel pressed in a hot press using low pressure. In gluing the core to the aluminum facings, a high-temperature-setting vinyl-phenolic glue formulation was used. The temperature

Table III. Sound Absorption Coefficients of Panels Having Various Facings and Corrugated Core Arrangement

Panel No.	*Description of Core*	*Facings*	*Total panel thickness, in.*	*Panel weight, lb./sq. ft.*	*Sound absorption coefficient at 500 c.p.s.*
1	All flutes parallel to each other; corrugated sheets separated by a flat sheet. Core placed in panel with flutes perpendicular to facings (PNL)	1/8-in. hardboard	1 1/4	2.0	0.04
2	Flutes of adjacent corrugated sheets at right angles. Core placed in panel with one half of the flutes perpendicular and one half parallel to facings (XN)	1/8-in. hardboard	1 1/4	1.9	0.04
8	Same as panel no. 1	1/8-in. hardboard with one facing perforated	1 1/4	2.0	0.56
9	All flutes parallel to each other; corrugated sheets separated by a flat sheet. Core placed in panel with flutes at a 45° angle to the facings (PNL diagonal)	1/8-in. hardboard with one facing perforated	1 1/4	2.0	0.71
10	Flutes of adjacent corrugated sheets at right angles. Core placed in panel with flutes at a 45° angle to the facings (XN diagonal)	1/8-in. hardboard with one facing perforated	1 1/4	1.8	0.61
3	Same as panel no. 1	1/16-in. white-pocket Douglas-fir veneer	1 1/4	1.1	0.62
12	Same as panel no. 9	1/16-in. white-pocket Douglas-fir veneer	1 1/8	0.8	0.60
11	Same as panel no. 1	0.020-in. aluminum with one facing perforated	1 1/16	1.0	0.51

of the press was about 300°F., but the panel was cooled under pressure before it was removed from the press.

METHOD OF TEST

Thermal Insulation

Thermal insulation tests of sandwich panels were conducted in the Forest Products Laboratory thermal conductivity apparatus, which consists of a heated central plate, $13^1/_2$ by $13^1/_2$ in., having two separate heat sources, one serving the center section, or test area (8 by 8 in.), and the other the border, or frame, which serves as a guard ring (Fig. 4). Two samples were tested at a time and were placed on opposite sides of the heated plate. Movable water-cooled plates were placed in contact with the samples. The heat flow with this arrangement was established from the heated center plate to the cooled outside plates. The amount of electrical energy supplied to the test area and guard ring was adjusted by potentiometers, so that the surface temperatures of the test area and guard ring were practically the same. When this adjustment was reached, the heat flow across the test sample was assumed to be uninfluenced by the area of the sample opposite the guard ring. In other words, the flow of heat was uniform over the test area and there was no loss of heat from the test area to the guard-ring zone. The auxiliary apparatus in show in Fig. 5.

Samples approximately 1 in. thick were tested between a hot-plate temperature of 102°F. and a cold-plate temperature of 55°F. The mean temperature was about 78°F.

Sound Absorption Tests

Sound absorption tests reported herein were made by the National Bureau of Standards. The so-called

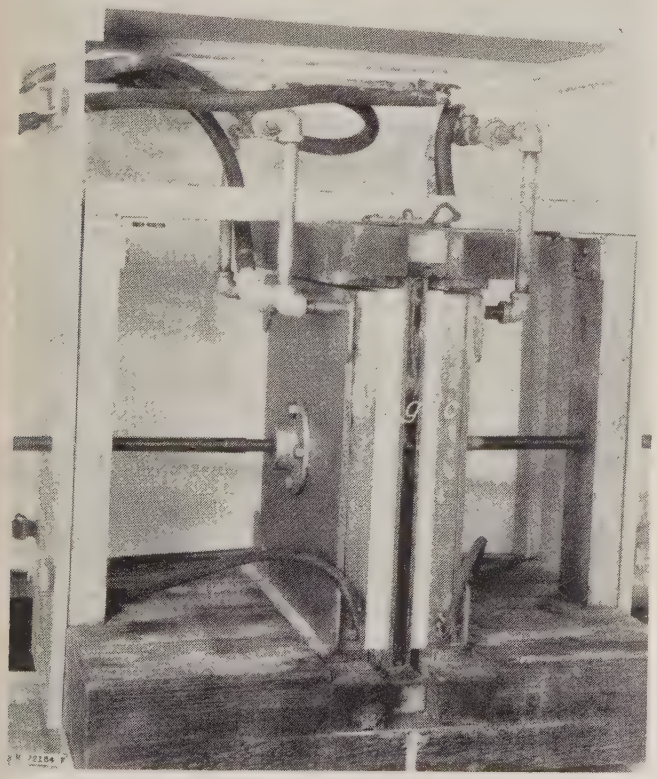


Fig. 4. Apparatus for determining thermal conductivity: c, plates cooled by running water; g, guarded hot plate; i, test samples. The front of the enclosure is removed

Fig. 5. Front view of test equipment for determining thermal conductivity. Enclosure for hot-plate equipment is at left

"box test" was employed. It is used in experimental and developmental work to indicate whether or not a material has promising sound absorbing properties. A more elaborate test, known as the reverberation chamber test, is used to determine accurate sound absorption coefficients for use in design data.

The box test as described by the National Bureau of Standards is made on a sample of material 12 by 36 in. in size at a single frequency of 500 cycles per sec. This test can be made only with the material applied to a rigid backing. In the case of acoustical tiles, the rigid backing consists of a brass plate which is placed behind the tiles in the box. The absorption of the test material is compared with the absorption of samples whose absorption coefficients had been determined previously in the reverberation chamber. The probable error of this type of test is estimated to be ± 0.05 in the second absorption coefficient.

RESULTS AND DISCUSSION

Thermal Insulation

Thermal conductivity values were determined on several different arrangements of corrugated paper core to compare their insulating characteristics (*3*). Cores in which the corrugated sheets were laid parallel to the faces had much better thermal insulating properties than those with the flutes perpendicular to the surfaces. Of the so-called flatwise cores the best results were obtained with cores in which the flutes of adjacent corrugated sheets were at right angles and flat sheets were laid between the corrugated sheets (Fig. 2, XNL—flatwise). The k value of 0.29 obtained with this construction approaches the value obtained with some of the common insulating materials used today. Slightly less effective was the core in which the corrugations were all parallel and flat sheets were laid between the corrugated sheets (Fig. 2, PNL—flatwise). Structures of this type however, do not have as good mechanical properties as those with vertical cells.

All of the cores having flutes perpendicular to the surface had relatively high conductivity values. A slightly lower conductivity was found in the core having one half of the corrugations running parallel to the surfaces (Fig. 2, XN). It was assumed that if the XN core were cut on a diagonal with the flutes the thermal conductivity might be improved, since the open path between one surface and the other would be lengthened. A core was tested with the flutes at a 45° angle with the sur-

faces. Surprisingly, this core had a slightly higher k value than the core with one half the flutes perpendicular to the facings. The PN core, which is similar in structure to the expanded or figure-8 cores, but has smaller cells, had a slightly higher k value than the XN core.

In the structures involving the uncorrugated flat sheet the density of the core was increased by the use of the flat sheet and the thermal insulation value reduced. All of these cores were made using the same weight of paper, and, therefore, the effect of core construction was not determined on a fixed-density basis.

For any given core construction the density of the structure affects the insulation value. The corrugated PNL core was fabricated from both a 50-lb. (lb. per 3000 sq. ft.) and a 30-lb. kraft paper. The heavier weight paper resulted in a core having a density of 5.5 lb. per cu. ft. and a k value of 0.59 as compared to a k value of 0.47 and a density of 3.35 lb. per cu. ft. for the core made from the 30-lb. paper (Table I). The reduction in weight of paper resulted in an appreciable reduction in the amount of cell wall material between the two surfaces.

One of the principal losses of heat through honeycomb core occurs by conduction through the paper itself. Some heat is also lost by convection in the air cells and some by radiation. In one instance, the contact area of both surfaces of the core was reduced by about 40% to minimize the area available for conduction. This was done by crushing circular areas in the surfaces of the core, leaving only sufficient contact area to produce a satisfactory bond strength between facings and core. This procedure reduced the conductivity from 0.59 to 0.52 B.t.u. per sq. ft. per hr. per in. per °F. This reduction was not enough to warrant further work.

Results of attempts to improve the thermal-insulating qualities of honeycomb core materials by foaming resins into the cells or by filling the cells with low density fill materials were promising (Table II). The k value of a given core construction was reduced from 0.58 for the unfilled core to 0.40 for the lowest density, foamed-in-place resin (resin A). This reduction in k value occurred in spite of the fact that the density of the core was increased about 50%. The other two foamed-in-place resins produced higher density cores and were not so effective to reducing the thermal conductivity value of the core. As stated earlier, the walls of the cells offered resistance to the foaming action, resulting in higher density than desirable.

It would seem possible to obtain still better thermal insulation properties with a core containing foam but lower in total density. With a core having relatively large cell openings ($1^1/_4$ in. diameter) a lower density foam was obtained that resulted in a core structure having a density of 1.9 and a k value of 0.31. This value approached that obtained when the resin was formed in block form without a web or core to obstruct the foaming action.

Slightly lower k values were obtained with the fill insulation than with the foamed-in-place resin. The silica aerogel fill material yielded a core with a k value of 0.35 as compared with 0.40 for a similar core with foamed resin, and 0.58 for the unfilled core.

In another corrugated-core arrangement all of the flutes were parallel to the surface, with the corrugated sheets separated by flat sheets (Fig. 2, PNL—flatwise), and the openings were filled with the silica aerogel fill insulation. The fill was responsible for a reduction in thermal conductivity from 0.31 to 0.27 B.t.u. per sq. ft. per hr. per in. per °F. This latter value is about equal to that commonly used for mineral-wool products. This particular core construction had disadvantages, which were mentioned earlier in the report.

Sound Absorption

Sound absorption coefficients for sandwich panels as determined by the National Bureau of Standards are given in Table III. Preliminary tests were first made on three sandwich panels, two with solid hardboard facings varying only in type of core construction and one faced with white-pocket Douglas-fir veneer. The results showed that neither of the two panels having solid hardboard facings had promising sound absorbing properties; thus it was not possible to explore the effect of core construction in this preliminary series. The panel faced with white-pocket Douglas-fir veneer, however, had promising absorbing properties. A sound absorption coefficient of 0.62 was determined for it, indicating possibilities of good sound absorbing properties for sandwich construction.

In the second series panels with perforations in one facing were used. Facings were of hardboard, aluminum, or white-pocket Douglas-fir veneer (natural holes). Core was placed in three of the panels with the flutes at a diagonal instead of perpendicular to the surface in an attempt to deflect the sound entering the panel. When the diagonal flute core was not used, perforations in one of the hardboard facings raised the sound absorption coefficient values from 0.04 to 0.56. A still higher coefficient, 0.71, was obtained when the flutes in the panel were at a diagonal, indicating some deflection of sound due to the walls of the cells. Utilizing the natural holes in white-pocket Douglas-fir veneer resulted in a panel having a sound absorption value of 0.60. Many of the common acoustical materials have sound absorption coefficients greater than 0.60 (*5*) which was about the average obtained on the sandwich panels with a perforated facing. An appreciable amount of sound is absorbed in these panels, and for many applications they would no doubt be acceptable. It may be possible to obtain higher coefficient values in this type of material by partially filling the cells of the core or by "roughing" the walls of the cells to increase the deflection of sound from the walls.

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ASSOCIATION NEWS AND EVENTS

TAPPI Annual Meeting

The following tentative schedule of sessions and papers to be presented at the Annual Meeting of the Technical Association of the Pulp and Paper Industry should be regarded as preliminary in nature and is subject to change prior to the meeting.

Monday, February 15

10:00 a.m. General Session (Ball Room)
2:00 p.m. Meetings of All Committees (all rooms)

Tuesday, February 16

9:15 a.m. Corrugated Containers (Grand Ball Room)
9:15 a.m. Digester Corrosion (Room B-C)
9:15 a.m. Papermaking (Fourdrinier) (East Ball Room)
9:15 a.m. Structural Fibrous Materials (Room A)
9:15 a.m. Papermaking (Cylinder) (West Ball Room)
2:00 p.m. Papermaking (Cylinder) (West Ball Room)
2:00 p.m. Acid Pulping (Room B-C)
2:00 p.m. Corrugated Containers (Grand Ball Room)
2:00 p.m. Papermaking (Fourdrinier) (Room A)
2:00 p.m. Wet Strength and Coating (South Room)

Wednesday, February 17

9:15 a.m. Corrugated Containers (Grand Ball Room)
9:15 a.m. Papermaking (Cylinder) (West Ball Room)
9:15 a.m. Pulp Purification (East Ball Room)
9:15 a.m. Statistics (Room B-C)
9:15 a.m. Testing and Chemical Methods (South Room)
2:00 p.m. Semichemical Pulping (East Ball Room)
2:00 p.m. Papermaking (Cylinder) (West Ball Room)
2:00 p.m. Corrugated Containers (Grand Ball Room)
2:00 p.m. Statistics (South Room)
2:00 p.m. Pulp Purification (Room B-C)

Thursday, February 18

9:00 a.m. Pulps for Chemical Conversion (Room B)
9:00 a.m. Water (West Ball Room)
9:00 a.m. Alkaline Pulping (Room C)
9:00 a.m. Microbiological (Room A)
1:00 p.m. Annual Luncheon

Note: All rooms except the South Room are located on the Ball Room floor. The South Room is located off the lobby on the street floor.

The following papers have been tentatively assigned to the various sessions. (Additional papers will be published in later issues of *Tappi*.)

General Session

"Fiberglas as a Papermaking Material," by Thomas S. Chambers, Owens-Corning Fiberglas Co., Newark, Ohio.

"The Pulp and Paper Industry in the Far East," by Roland A. Packard, Washington, D. C.

Corrugated Containers

Digester Corrosion

Papermaking (Fourdrinier)

"Use of the Tracerlab Mass per Unit Area Instrument on Newsprint Felt Wear and Wire Wear."

"Load Meters, Tension Meters, and Torque Meters for Paper Machines," by John C. Harper, Jr., Downingtown Mfg. Co., Downingtown, Pa.

"Use of Television in Paper Mills," by Lyle B. Schueler, Diamond Power Specialty Co., Lancaster, Ohio.

"An Experimental Study of the Factors Involved in the Manufacture of Paper Yarn," by Goeffrey Broughton and James P. Wang, Lowell Technological Institute, Lowell, Mass.

Structural Fibrous Materials

"The Importance of Speed of Test on Bending Strength Properties of Insulating Board," by Wayne C. Lewis, Forest Products Laboratory, Madison, Wis.

"A Comparison of the TAPPI-SFMC Drainage Time Test Procedure with Other Methods," by David R. P. Haig, Johns-Manville Research Center, Manville, N. J.

"Evaluation of the TAPPI-SFMC Drainage Time Tester from TAPPI T 1002 sm-51," by Jules Perot, Flintkote Co., Whippany, N. J., and C. E. Hrubesky, Forest Products Laboratory, Madison, Wis.

"Drainage Time Testing of Insulating Board Stocks and the Features and Shortcomings of the Test." Panel discussion by Thure C. Duval, Wood Conversion Co., Cloquet, Minn., C. E. Hrubesky, Jules Perot, and D. R. P. Haig.

Papermaking (Cylinder)

"Design and Operation and Their Effects on Finish."

Acid Pulping

"Prediction of Brightness of Groundwood-Sulphite Pulp Mixtures," by D. J. MacLaurin, Institute of Paper Chemistry, Appleton, Wis., and F. A. Aflenzer, Forest Products Laboratory, Madison, Wis.

Coating

"Film Splitting in Roll Coating Operations," by John W. Hanson, Institute of Paper Chemistry, Appleton, Wis.

Pulp Purification

"New Process for the Bleaching of Chemical Pulps, Especially Kraft with Either Sodium Peroxide or Hydrogen Peroxide," by W. F. Schroeder, National Distillers Chemical Co., Ashtabula, Ohio.

Statistics

Testing and Chemical Methods

"The Effect of Copper and Base Concentrations in Cellulose Solvents," by B. L. Browning, Institute of Paper Chemistry, Appleton, Wis.

"The Chapman Smoothness Tester." Three papers by representatives of The Institute of Paper Chemistry, Pulp and Research Institute of Canada, and the West Virginia Pulp & Paper Co.

"The Interrelation of Fiber Length Distribution, Fiber Length Index and Physical Characteristics of Hand Sheets," by A. H. Nadelman, R. Schmut, D. J. Kraske, and R. I. Larson, Western Michigan College, Kalamazoo, Mich.

"Chromatographic Techniques in the Analysis of Purified Pulps," by J. F. Saeman, W. E. Moore, and R. L. Mitchell, Forest Products Laboratory, Madison, Wis.

Semichemical Pulping

"Analysis of Semichemical Equipment Survey," by J. E. Sapp, Gaylord Container Corp., Bogalusa, La.

"Cohesive Ratings of Semichemical Pulped Chips," by J. S. Hart, Pulp and Paper Research Institute of Canada, Montreal, P. Q.

"Influence of Hemicelluloses in Semichemical Pulp," by D. J. MacLaurin, Institute of Paper Chemistry, Appleton, Wis.

"Effect of Cooking Conditions in Semichemical Pulping of Gumwood," by G. C. Kimble, Union Bag & Paper Corp., Savannah, Ga.

"Properties of Semichemical Pulps," by E. H. Shriver, Mead Corp., Chillicothe, Ohio.

"An Orienting Study of the Effects of Neutral Sulphite Semichemical Cooks on the Hemicelluloses of Aspen Wood," by Daniel C. Lea, Institute of Paper Chemistry.

Pulps for Chemical Conversion

"Problems in the Evaluation of Caustic Absorbency of Pulp Sheets," by R. W. Swinehart and A. T. Maasburg, Dow Chemical Co., Midland, Mich.

Paper by Merle Heath, Buckeye Cotton Oil Co., Memphis, Tenn.

Paper by R. C. Blume, Du Pont, Richmond, Va.

"Purified Hardwood Pulps for Chemical Conversion II."

"Prehydrolysis Sulphate Pulps from Sweetgum," by F. A. Simmonds, J. S. Martin, and R. M. Kingsbury, Forest Products Laboratory, Madison, Wis.

"Investigation of Haze in Cellulose Acetates Made from Wood Pulps," by Keith E. Bradway, Camp Mfg. Co., Franklin, Va.

"A Cellulose Yield Test Which Overcomes the Inadequacies of the Alpha Cellulose Test," by Frank R. Charles, Industrial Cellulose Research, Ltd., Hawkesbury, Ont.

Chemical Engineering

"Bibliography on Alkaline Digester Corrosion," by R. P. Whitney, Institute of Paper Chemistry, and S. J. Baisch, Thilmany Pulp & Paper Co., Kaukauna, Wis. (By Title.)

Water

"Stream Pollutional Aspects of Mill Antiseptics," by W. M. Van Horn, Institute of Paper Chemistry, Appleton, Wis.

Alkaline Pulping

"The Effect of Alkaline Pulping on the Lignin of *Eucalyptus regnans*," by J. W. T. Merewether (Australia).

"Lime Sludge," by representative of Allis-Chalmers Mfg. Co., Milwaukee, Wis.

Microbiological

"The Biological Inactivation of Mercurials by Pulps," by B. F. Shema, Institute of Paper Chemistry, Appleton, Wis.

Local Sections

Pacific (West Linn, Ore., March 19, 1954): Annual Shibley Award Contest.

Lake States (Conway Hotel, Appleton, Wis., Jan. 12, 1954): Panel Discussion on "Refining"; Reinhold A. Vogt, Combined Locks Paper Co., Combined Locks, Wis., Moderator.

Delaware Valley (Riegel Ridge, N. J., Clubhouse of the Riegel Paper Corp., Dec. 4, 1953): Panel Discussion on "Dimensional Stability of Paper."

Kalamazoo Valley (Hotel Harris, Kalamazoo, Mich., Dec. 3, 1953): "Significance of Paper Tests," by J. A. Van den Akker, Institute of Paper Chemistry, Appleton, Wis.

New England (Roger Smith Hotel, Holyoke, Mass., Dec. 4, 1953).

Ohio (American Legion Hall, Middletown, Ohio): Panel Discussion on "Recent Pulp Developments."

Empire State Metropolitan District (Fraunces Tavern, New York, N. Y., Dec. 8, 1953).

Empire State Northern District (Martinas Restaurant, Watertown, N. Y., Dec. 10, 1953): "Slime Control," by Paul A. Sartoretto, W. A. Cleary Corp., New Brunswick, N. J.

Empire State Western District (Prospect House, Niagara Falls, N. Y., Dec. 2, 1953): "The Efficient Use of Dyestuff in Paper Making," by E. P. McGinn, Sandoz Chemical Works, New York, N. Y.

Empire State Eastern District (Glens Falls, N. Y., Dec. 17, 1953): "Wood Conservation and Utilization."

Empire State Central District (University Club, Syracuse, N. Y., Dec. 4, 1953): "Cylinder Felts for the Syracuse Area," by Bert L. Channer, H. Waterbury & Sons Co., Oriskany, N. Y.

Southeastern (Fort Sumter Hotel, Charleston, S. C., Dec. 4, 1953).

Technical Section, Canadian Pulp and Paper Association (Sheraton Mt. Royal Hotel, Montreal, P. Q., Jan. 28–30, 1954).

Foreign Technical Associations

France

Association Technique de l'Industrie Papetiere (ATIP), 154 Blvd. Haussmann, Paris 8, France (665 members). President, P. Champeaux; Secretary General, P. Turel.

Australia

Australian Pulp and Paper Industry Technical Association (APPITA) c/o Div. of Forest Products, Commonwealth Scientific and Industrial Research Organization, Yarra Bank Rd., South Melbourne, Victoria, Australia (609 members). President, J. D. Andrews; Secretary, R. W. Smith.

Denmark

Danske Papiringeniores Forening, 18 St. Strandstraede, Kobenhavn J, Denmark (32 members). Chairman, L. C. Carlsen; Secretary, O. Hallin.

Norway

Papirindustriens Tekniske Forening, 14 Shortingsgaten, Oslo IV, Norway (447 members). Chairman, Aug. Knudtzon.

Finland

Suomen Paperiinsinoorien Yhdistys, 19 Uniongaten, Helsinki, Finland (572 members). President, Heikki Sihtola; Secretary, G. Rurik Gustafsson.

Canada

Technical Section, Canadian Pulp and Paper Association, 3420 University St., Montreal, Que. (1514 members). Chairman, R. L. Fraser; Executive Secretary, Douglas Jones.

Great Britain

Technical Section, British Paper and Board Makers Association, Inc., St. Winifred's, Welcomes Rd., Kenley, Surrey, England (1631 members). Chairman, I. G. Burns; Secretary, F. M. Bolam.

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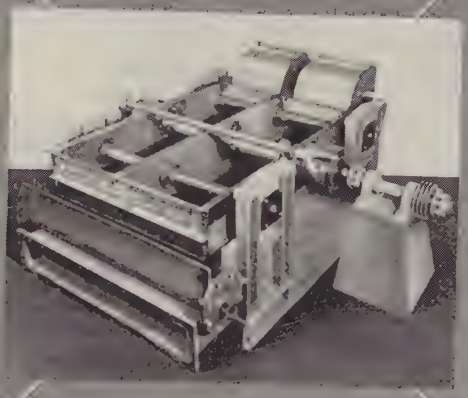

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SWEDEN

Svenska Pappers-och Cellulosaingeniorsforeningen, 4A Sodra Blasieholmshamnen, Stockholm C, Sweden (800 members). Chairman, Henning Wadel; Technical Secretary, Sven Westerberg.

JAPAN

Japanese Technical Association of the Pulp and Paper Industry, 2 Mitsubishi Naka-14 Bldg., Marunouchi, Tokyo, Japan.

Pulp and Paper Manufacture IV

The fourth volume of "Pulp and Paper Manufacture," published by the McGraw-Hill Book Co. in manuscript form, has been transmitted to the Editing and Production Depts. of the Book Company. It is tentatively scheduled for publication and distribution in September, 1954.

Pulp Testing Committee

Frank E. Caskey, research chemist for the Crown Zellerbach Corp., Central Research Dept., Camas, Wash., has been appointed chairman of the TAPPI Pulp Testing Committee succeeding Robert I. Thieme of the Scott Paper Co., Soundview Div., Everett, Wash.

Fundamentals of the Paper Machine

The TAPPI Fundamental Research Committee is planning to sponsor an international conference in the Fall of 1954 on the "Fundamentals of the Paper Machine" at Appleton, Wis. It is possible that this conference may be of four or five days' duration.

It is expected that the program will feature the following subjects:

1. Properties of Fiber Suspensions.
2. Water Removal from Fiber Suspensions and Mats.
3. Cohesive, Adhesive, and Felting Properties of Fibers.
4. Compression and Stressing of Fiber Mats.

Although the program is now only in the formative stage, considerable attention has been given to it by the TAPPI and CPPA Technical Section Committees on Fundamental Research.

Under (1) Properties of Fiber Suspensions, it has been tentatively decided to have Mr. Rausch of Iowa State College give a general lecture on "Turbulence." This will be followed by a paper by J. A. Van den Akker of The Institute of Paper Chemistry on "Turbulence and Pressure Drops" and S. G. Masar of the Pulp and Paper Research Institute of Canada on "Flocculation."

Under (2) Water Removal from Fiber Suspensions and Mats, it is expected that the principal lecture "Thermodynamics of Water Removal" will be given by T. K. Sherwood of the Massachusetts Institute of Technology. Following Mr. Sherwood's lecture there will be papers dealing with "Filtration of Pulp Suspensions," by Messrs. Whiting and Ingmanson of The Institute of Paper Chemistry; "The Mode of Water Removal," by Messrs. Rance and Bennett of Great Britain; "Densification of Wet Mats," by Mr. Iversson of the Swedish Forest Products Laboratory; and "Drying," by S. T. Han of The Institute of Paper Chemistry.

Under (3) Cohesive, Adhesive, and Felting Properties of Fibers, there may be a general lecture by W. Galley of the E. B. Eddy Co. Following this W. Brecht of Darmstadt, Germany, might talk on "The Wet Strength of the Sheet" and Mr. Anderson of the Swedish Forest Products Laboratory may talk on "The Mechanism of Sheet Transfer."

F. E. Caskey, Crown Zellerbach Corp.; Chairman, Pulp Testing Committee

R. L. Lewis, Ohio Boxboard Co.; Chairman, Lake Erie Section

Under (4) Compression and Stressing of Fiber Mats, the feature lecture may be given by Mr. Nisson of Sweden. Specific papers may include "Shrinkage in Drying," by Mr. Rance of Great Britain; "Stress-Strain," by Borge Steenburg, Royal Institute of Technology, Stockholm, Sweden; and "Wet-Pressing," by D. J. MacLaurin of The Institute of Paper Chemistry.

In addition, there will be a panel discussion on "The Application of Fundamental Knowledge of the Properties of Pulp Suspensions to the Design of the Paper Machine."

If it is considered advisable to have a fifth session it is possible that there will be a paper by Mr. Brecht of Darmstadt on "Calendering." Mr. Duncan of the International Paper Co. may present a paper on "Deaeration on the Behavior of Air in Pulp Suspensions"; G. F. Underhay of Bowaters Research and Development, Ltd. on "Suction Pickup"; and a paper sponsored by F. C. Huyck & Sons on "Felt Design and the Effect of Water Removal." These papers may be followed by a panel discussion on "Pressure Forming."

At the banquet two presentations are planned, one by an old-timer who will talk on the "Art of Operating a Paper Machine" and one by someone who will give a speculative talk on "The Complete Elimination of Water on the Paper Machine."

Lake Erie

The Lake Erie Section meets monthly at the Carter Hotel, Cleveland, Ohio, unless otherwise indicated. The following schedule of meetings has been announced by R. L. Lewis, Ohio Boxboard Co., Rittman, Ohio, chairman:

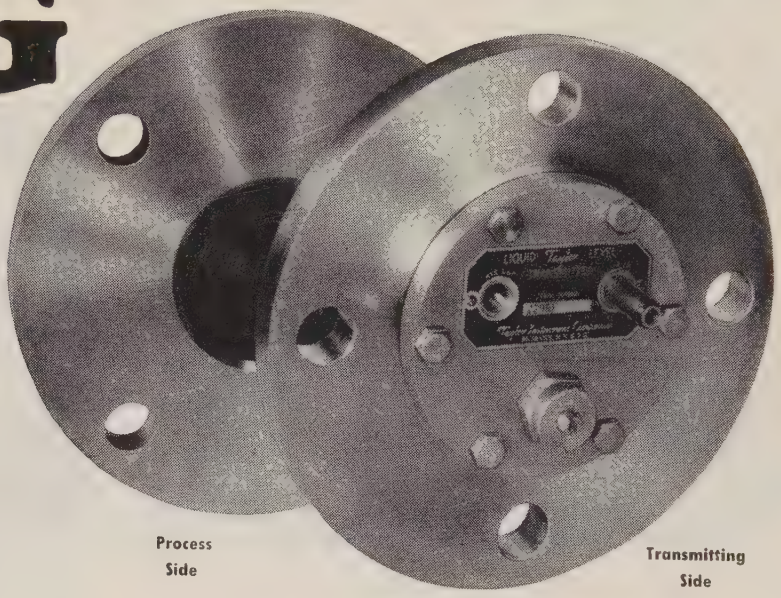
Sept. 25, 1953: "Shipping Claim Reduction (meeting held in Monroe, Mich.).
Oct. 16, 1953: "Specialty Adhesives."
Nov. 20, 1953: "Corrugating Quality."
Dec. 12, 1953: Christmas Party.
Jan. 15, 1954: "Human Relations."
Feb. 19, 1954: "Packaging from the Consumer's Viewpoint."
March 19, 1954: "Chemicals as Aids to the Papermaker and Converter."
April 16, 1954: "Modern Woman Dictates Today's Product Development."
May 21–22, 1954: "Graphic Arts."
June 1954: Golf Outing.

Empire State Central District

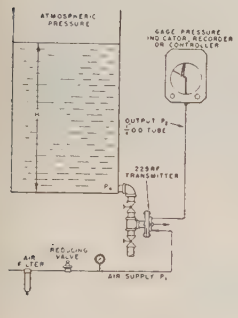
The Central District of the Empire State Section meets each month at the University Club in Syracuse, N. Y. The schedule of its meetings for 1953–54 follows:

Oct. 2, 1953: "Set-up and Folding Boxes," by Edward K.

DOESN'T CORRODE or CLOG

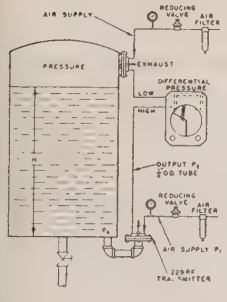


APPLICATIONS



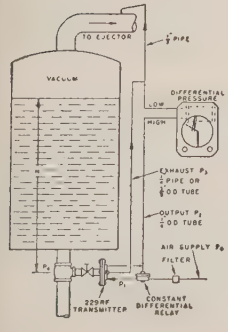
1

For Open Tanks. A typical Taylor 229R Transmitter installation on an open tank as used in **BLEACH TOWER, BLACK LIQUOR, SMELT DISSOLVING, PULP STORAGE, HEAD-BOXES, SIZE TUBS,** and stock lines, or for pressure measurement in pipe lines.



2

For Closed Tanks Under Pressure. Here transmitters are installed at both bottom and top of the tank and the differential pressure is measured by a mercury or aneroid manometer. Typical uses **—ACCUMULATORS, ABSORPTION TOWERS.**



3

For Closed Tanks Under Vacuum. For example, **DEAERATORS, VACUUM RECEIVERS.**

TAYLOR LIQUID LEVEL TRANSMITTER

Want to measure accurately the level of liquids that are corrosive or viscous—or contain solids? The Taylor 229R Liquid Level Transmitter is a force-balance unit specifically designed to measure pressure and liquid level of viscous or corrosive liquids and liquids containing solids. No levers or cams, so no frictional error. It's adaptable to open as well as closed tanks, under pressure or vacuum, and can be attached to the bottom or side of the tank to give accurate level measurement. Output can be connected with an indicator, recorder or controller as much as 1,000 ft. away from transmitter.

This is another example of how Taylor instrumentation can help you cut costs and protect product quality in almost every phase of paper manufacture. Ask your Taylor Field Engineer or write for **Bulletin 98069.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

Mullin, Sales Manager, Boxboard Div., Robert Gair Co., New York, N. Y.
Nov. 6, 1953: "Cylinder Machine Vats," by Harold A. Norseen, Pusey & Jones Corp., Wilmington, Del.
Dec. 4, 1953: "Cylinder Felts for the Syracuse Area," by Bert L. Channer, H. Waterbury & Sons Co., Oriskany, N. Y.
Jan. 8, 1954: "The Relation of Paper Quality to Corrugating Board Sales," by W. J. Trimble, Manager, Robert Gair Co., Syracuse, N. Y.
Feb. 5, 1954: "Use of Starches as an Additive and Adhesive in Paper and Paperboard," by James P. Casey, A. E. Staley Mfg. Co., Decatur, Ill.
March 5, 1954: "The Manufacturing of Tissues," by W. H. Hall, Victoria Paper Mills Co., Fulton, N. Y.
April 2, 1954: "Printing of Paper and Paperboard," by Frank B. Lincoln, Time-Life Laboratories, Springdale, Conn.
May 7, 1954: New York State College of Forestry Night—C. H. Kent, Hercules Powder Co., Holyoke, Mass., guest speaker.
June 4, 1954: Annual meeting.

TAPPI Executive Committee Meeting

The Executive Committee of the Technical Association held its first meeting in the new quarters of the Association in the Commerce Bldg. in New York on Sept. 14, 1954.

The photograph of the members of the Committee present is shown in the new conference room of the Association. Seated left to right are: C. J. Sibler, West Virginia Pulp & Paper Co., New York, N. Y.; W. D. Harrison, Riegel Paper Corp., Milford, N. J.; W. F. Hathaway, Kalamazoo Vegetable Parchment Co., Kalamazoo, Mich.; George A. Day, Brown Co., Berlin, N. H.; K. O. Elderkin, Bowaters Southern Paper Corp., Calhoun, Tenn.; George H. Pringle, Mead Corp., Chillicothe, Ohio; R. G. Macdonald, TAPPI, New York, N. Y.; J. R. Lientz, Union Bag & Paper Corp., Savannah, Ga.; Harry C. Moore, Beloit Iron Works, Beloit, Wis.; John Buss, Provincial Paper Ltd., Toronto, Ont.; and L. K. Burnett, Ohio Boxboard Co., Rittman, Ohio.

G. W. E. Nicholson to Receive TAPPI Medal

Gunnar W. E. Nicholson, executive vice-president of the Union Bag & Paper Corp., has been chosen by the TAPPI Executive Committee to receive the 1954 TAPPI Medal.

The TAPPI Medal is awarded to an individual who has made an outstanding contribution to the technical advancement of the pulp and paper industry.

Nr. Nicholson was born in Sweden on July 11, 1893, and graduated as a chemical engineer from Chalmers Institute of Technology in 1916. From 1916 to 1927 he held various jobs in a number of paper mills in Sweden, Canada, and the United States. From 1927 to 1931 he was general superintendent of the Bogalusa Paper Co., Bogalusa, La. Between 1931 and 1941 he was superintendent and manager of the Mobile, Panama City and Georgetown mills of the Southern Kraft Div., International Paper Co. From 1941 to 1945 he was resident manager of the Savannah, Ga., mill of the Union Bag & Paper Corp. In 1945 he became vice-president of the company.

Mr. Nicholson was President of TAPPI in 1946.

In 1946 he was awarded the golden medal by the Swedish Association of Pulp and Paper Engineers for his outstanding contributions to international pulp and paper technology. At the same time he was voted an honorary membership in the Association, an honor bestowed on only three other persons. In 1949 he was decorated with the Royal Order of Vasa, rank of Knight, First Class, by his Majesty Gustaf, King of Sweden, for his contribution to industry cooperation between the United States and Sweden.

Power Requirements for Chippers

The Chipper Subcommittee of the TAPPI Electrical Engineering Committee met at the Henry Grady Hotel, Atlanta, Ga., on Sept. 22, 1953, to discuss the responses to its questionnaire on power requirements for chippers.

Reading left to right around the table: G. L. Oscarson, Electric Machinery Manufacturing Co.; O. L. Calhoun, Crossett Paper Mills; W. V. Knight, Gaylord Container Corp.; N. H. Mailhos, Brunswick Pulp and Paper Mill; M. M. Stokely, J. E. Sirrine Co.; N. P. Wardwell, Carthage Machine Co.; Stan Bobe, Westinghouse Electric Corp.; R. R. Baker, Westinghouse Electric Corp.; S. B. Barrow, General Electric Co.; G. E. Shaad, General Electric Co.; and M. J. Osborne, Bowaters Southern Paper Corp.

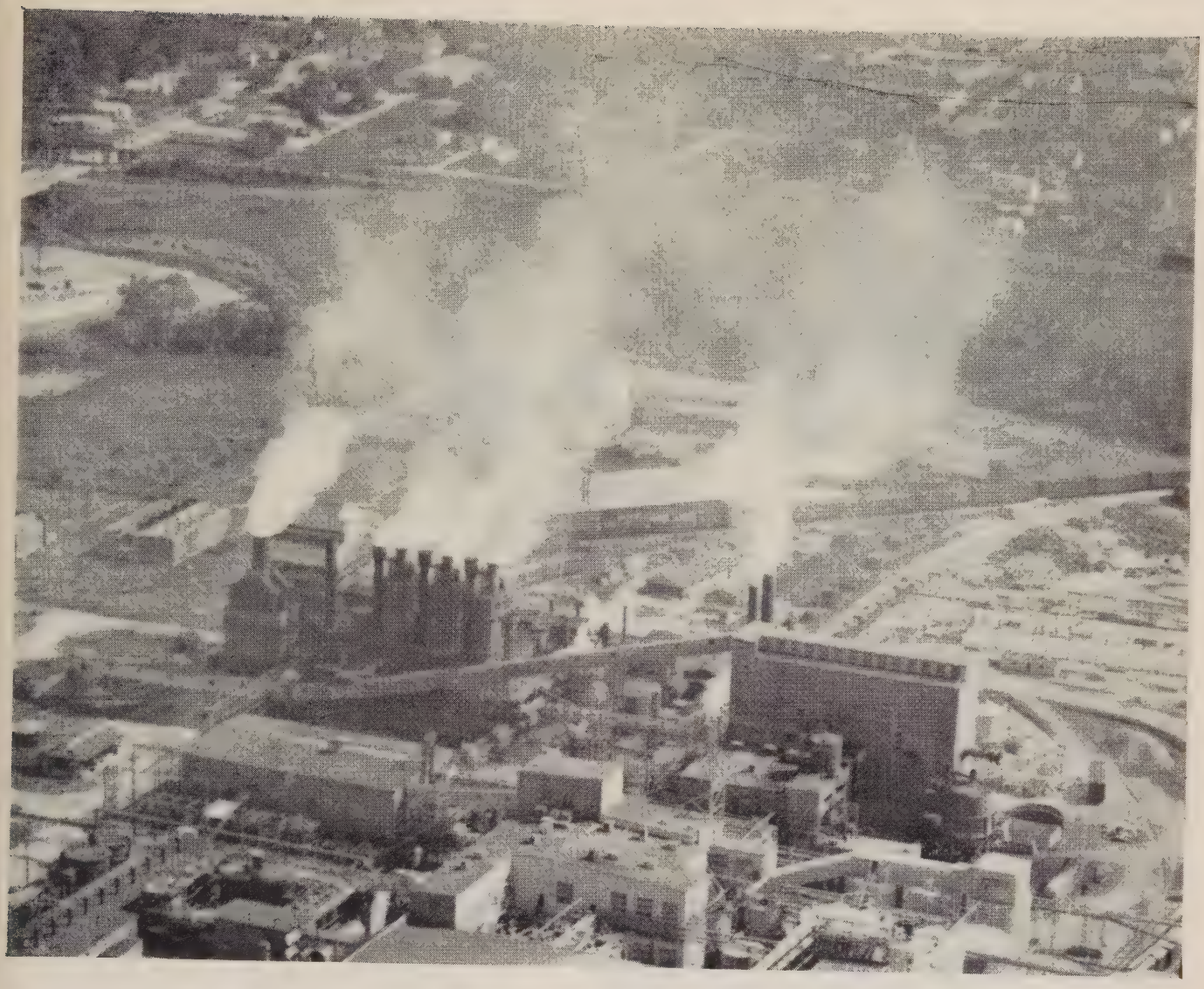
Although excellent responses have been received all companies that have not completed their questionnaires are urged to do so since better conclusions can be arrived at if the responses received are fully representative of the industry. A preliminary report of the survey was made at the TAPPI Engineering Conference held at Montreal in October.

The members of the committee present at Atlanta included: M. J. Osborne, chairman, Bowaters Southern Paper Co.; G. L. Oscarson, Electrical Machinery & Mfg. Co.; O. L. Calhoun, Crossett Paper Mills; W. V. Knight, Gaylord Container Corp; N. H. Mailhos, Brunswick Pulp & Paper Co.; M. M. Stokely, J. E. Sirrine Co.; N. P. Wardwell, Carthage Machine Co.; Stan Bobe and R. R. Baker, Westinghouse Electric Corp.; S. B. Barrow and G. E. Shaad, General Electric Co.

Fibrous Agricultural Residues Conference

The 10th Annual Conference sponsored by the TAPPI Fibrous Agricultural Residues Committee was held at Belleville, Ont., on Oct. 8–9, 1953. Samuel I. Aronovsky of the Northern Regional Research Laboratory, Peoria, Ill., presided as chairman.

A feature of the conference on Friday, October 9, was a visit to the Trenton, Ont., mill of Hinde & Dauch of Canada,



There's good will in the air

. . . when your odor abatement program is really effective

Even at the most modern pulp mills, escaping sulfide odors continue to be a major problem. Condensing, scrubbing, or burning the waste gases have not been the complete solution to effective odor abatement—odor abatement that literally means "good will in the air."

Du Pont chemists and engineers, who have worked closely with management, engineers, and production men at most of the country's leading pulp mills, turned their attention to helping them work out their waste gas odor problems. As a result of these experiences, specially engineered odor-masking compounds—Du Pont "ALAMASK" odor-masking compounds—were developed.

In actual mill operations, the use of "ALAMASK" has effectively reduced the noticeable malodors. As these operations continue, priceless good will is being built for the mills with their communities and with their employees.

Perhaps Du Pont "ALAMASK" odor-masking compounds, combined with Du Pont experience in the pulp and paper industry, can be the answer to your odor abatement problem. For information and technical service, write to E. I. du Pont de Nemours & Co. (Inc.), Organic Chemicals Department, Wilmington, Delaware.

Du Pont **Alamask**
REG. U.S. PAT. OFF.
Odor-Masking Compounds

DU PONT
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BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Ltd. where the new Va-Purge Process for cooking straw was observed.

The group dinner on October 8 was featured by an address on "Peanuts and Progress" by L. R. Thiesmeyer, president of the Pulp and Paper Research Institute of Canada, Montreal, P. Q. The dinner was preceded by a social hour, compliments of Hinde & Dauch of Canada, Ltd.

The Thursday morning meeting was opened by the introduction of the 30 individuals present by Mr. Aronovsky. William H. Palm, vice-president of Hinde & Dauch of Canada, Ltd., made the address of welcome. R. G. Macdonald, Secretary-Treasurer of the Technical Association of the Pulp and Paper Industry, gave a talk on "TAPPI and the Strawboard Industry." Mr. Macdonald's presentation follows.

TAPPI and the Strawboard Industry

R. G. Macdonald

In planning the Tenth TAPPI Fibrous Agricultural Residues Conference Mr. Aronovsky asked the speaker to point out briefly the services of the Technical Association of the Pulp and Paper Industry available to the strawboard industry.

The objective of the Association is expressed in a few words on its letterhead. It states that the Association is organized for the search and dissemination of knowledge relating to pulp and paper.

To accomplish this objective the Association has made a long-time effort to induce individuals and companies to become members. The special interests of its members over the years have been recognized in the establishment of divisions and committees. The scope of these committees has been carefully defined and for administrative purposes they have been classified in seven major divisions.

The TAPPI divisions include: Engineering, Testing, Pulp Manufacture, Paper Manufacture, Converting and Consuming, Research Development, and Industrial.

The Industrial Division is made up of Cost Engineering, Training and Education, Nonfibrous Raw Materials, Water, Structural Fibrous Materials, and Fibrous Agricultural Materials Committees. This division is rather heterogeneous in constitution but it will be noted that it deals with fields that are either of over-all interest to all branches of the industry or it deals with branches of the industry that, in a sense, are separate industries themselves such as the strawboard industry or the wallboard and insulating board industries.

The Association is so organized that it can establish groups that have aspects distinctive in themselves. Although the divisional organization is largely functional in scope the Fibrous Agricultural Residues Committee, serving the strawboard industry, is organized through subcommittees to feature functions that are of particular interest to strawboard manufacturers and tend to parallel a large part of the divisional structure.

The great value of an organization such as TAPPI to an industry such as your own is its wide diversification of interests. Possibly, a review of some of these interests as expressed in terms of the Association's divisions and committees will point out ways in which strawboard manufacturers can receive special benefits.

Next week in New York will be held our annual Corrugated Containers Conference. It is possible that some of you gentlemen will be present. I know that you are concerned with many aspects of corrugating. The New York meeting will feature printing as applied to corrugated containers. Future meetings sponsored by the Corrugated Containers Committee will deal with other major problems of the industry.

The Corrugated Containers Committee is a part of the TAPPI Converting and Consuming Division. Associated with it are committees dealing with Container Evaluation and Development, Coating, Wet Strength, and Plastics. It is quite possible that sooner or later the objectives of all of these committees may interest you as strawboard or straw papermakers.

Although your committee has a pulping subdivision which meets your individual needs you should be interested in some of the work of the TAPPI Pulp Manufacture Division which includes committees on Acid Pulping, Alkaline Pulping, Semichemical Pulping, Mechanical Pulping, Paper Deinking, Chemical Products, Pulp Purification, and Pulps for Chemical Conversion. The work of the Semichemical Pulping Committee should be of particular interest to you both from the competitive aspect and by a consideration of its chemical procedures that may have some adaptation possibilities to strawboard manufacture.

At this conference I believe that you will have an opportunity to investigate the new Va-Purge Process which was developed for wood but has, I understand, been applied to straw by your host company, Hinde & Dauch of Canada. One interesting consideration of this process is the possibilities that are demonstrated for a continuous pulping operation, and ultimate aim in all chemical engineering endeavors.

Throughout the pulping operations processes such as screening, washing, thickening and bleaching are considered.

Another division concerns itself with Paper Manufacture and includes committees dealing with the Preparation of Papermaking Materials, Cylinder Machines, and Fourdrinier Machines. All of these operations will soon be common to strawboard mills as well as to other branches of the industry.

Our committees dealing with the two major types of paper machine operations are relatively new and are trying to develop a scope that will permit cooperative study. In this connection it is interesting to note that the Association, in the Fall of 1954, will conduct an international conference at Appleton, Wis., dealing with the Fundamentals of the Paper Machine. This conference will be sponsored by the TAPPI Fundamental Research Committee and will consider such fundamental concepts as filtration, density, drying, pressing, etc. from the standpoint of the research scientist. It will be the first effort made to analyze the art of papermaking on a scientific basis.

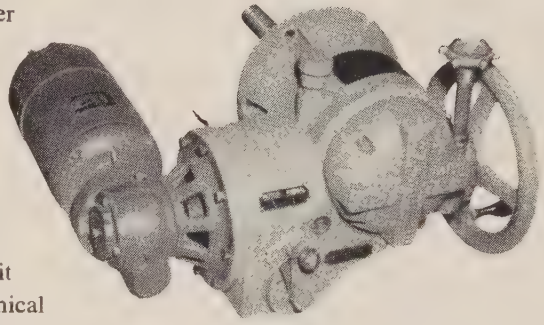
Recently, the Association conducted a Testing Conference in Columbus, Ohio. Participation was limited to the work of our Paper Testing and Wax Testing Committees. However, other committees are working in the fields of Fibrous Materials Testing (which includes the consideration of straw), Pulp Testing, Optical Properties, Microscopy, Container Testing, Packaging Materials Testing, and Chemical Methods Committees.

The work of all of these committees is important to all branches of the industry. You may be familiar with the ultimate objectives of these committees as represented in the world-known TAPPI Standard Testing Methods, Specifications, and Recommended Practices. In addition to the Standards, the Association established another useful service, a few years ago, which deals with Routine Control Methods. The latter are methods used in a practical way in pulp and paper mills for the purpose of estimating qualities during mill operation periods. They are tests that are considered suitable for the purpose but for one reason or another are, at present, not eligible for establishment as tentative standards or suggested methods. It is hoped, however, that many routine tests may be developed into recognized standard procedures.

The Association is proud of its accomplishments in the field of Standard Testing Procedures. They are used throughout the world and have been incorporated into a large number of

R. G. Macdonald, Secretary-Treasurer of the Technical Association of the Pulp and Paper Industry, New York, N. Y.

this jordan has a mind of its own



The jordan dates from 'way back when, but until the Duotrol* plug adjuster came along it never had a mind of its own . . . With Duotrol, every variation in stock density or flow sends an impulse to the plug, setting it up or backing it off automatically. Thinking for itself, a jordan with Duotrol delivers uniform stock treatment regardless of density or flow conditions . . . Without Duotrol a jordan is pretty much a hit and miss operator—and the same goes for conical type refiners. With Duotrol your jordans—and refiners have minds of their own . . . Specify Shartle-Miami.

*Trade-mark

BLACK-CLAWSON

SHARTLE BROS. MACHINE DIVISION • MIDDLETOWN, OHIO

government purchasing specifications. Much effort has been made to create these standards. In some cases a number of years is required to prepare a satisfactory tentative standard. Before it can become an official standard of the Association it must be approved by three quarters of the membership of its sponsoring committee. It then must be approved by the Standards Committee and voted on by the entire active membership of the Association. When submitted to the entire active membership even one well-qualified, substantiated objection will prevent its acceptance as an official method.

Later this month the Association will conduct its Eighth Annual Engineering Conference which will be sponsored by its Engineering Division at Montreal. As in the case of most of the Association conferences the location is changed from year to year to broaden interest and to enable more individuals to attend. The Engineering Conference is one of the most successful meetings held by the Association. Its attendance ranges upward from 600 individuals and its programs are prepared with great care to meet the needs of the engineers throughout the industry.

Each of the committees in the Engineering Division is responsible for a portion of the annual conference which is organized so that all who are present may attend all of the committee sessions. The divisional committees include Steam and Power, Materials Handling, Drying and Ventilating, Engineering Research and Machine Design, Mill Design and Economic Aspects, Hydraulics, Mill Maintenance and Materials, Electrical Engineering, Chemical Engineering (including its Digester Corrosion Subcommittee), and Data Sheets committees.

The Data Sheets Committee is now undertaking the preparation of a Paper Mill Engineering Handbook which should be of great value to the industry when it is completed.

Finally, we may mention our Research Development Division with its committees on Bibliography, Fundamental Research, Statistics, Microbiology, and Patents.

The work of the TAPPI Bibliography Committee, especially under the direction of the late Clarence J. West, may be considered to be phenomenal. Its work covering the entire pulp and paper industry literature since 1900 is a record unmatched by any other industry.

Our Fundamental Research Committee has made a practice of delving into the fields served by other committees and the results have been very stimulating.

The Statistics Committee has conducted two very successful two-week courses in the subject of quality control. It is a pioneering group and has felt the need of providing training at the college level to enable more individuals to become acquainted with this new and important approach to testing and quality control. The mastery of the use of these new techniques has a high monetary value to the companies that learn how to use it.

I have sketched the divisional organization of the Association and I am sure that you have noted that mention of many committees whose efforts should benefit the strawboard industry.

The committees accomplish their objectives through committee meetings, national conferences, correspondence, questionnaires, etc. To bring their accomplishments to our members and to the industry, publication resources exist. The best known medium for publishing their work is *Tappi*, the monthly magazine issued by the Association. This publication was started in 1949 and succeeded an annual volume called *Technical Association Papers*. It reproduces the papers and discussions presented at conferences such as this. It also carries a continuous record of the efforts being made by our committees, and includes news items of particular value to men in management and operating activities.

The reports of the Association's local sections are published rather completely in *Tappi*. The local sections are regional groups of members and nonmembers who hold frequent meetings in the pulp and papermaking regions to discuss subjects of local interest. The publication of their meeting reports is mentioned here since they deal with nearly all of the subjects represented by our division and committee structure and handle such subjects, for the most part, on a very practical basis rather than on the more highly technical basis common to the national meetings.

Frequently, a committee attempts to bring together all of the important information relating to some phase of its scope. It does this in the form of TAPPI Monographs. Several monographs are in preparation and ten have been completed. Of the monographs completed about five have dealt with major branches of the coating industry. Others have dealt with pulpwood, chemical constituents of wood, resins, and pulp bleaching. The latter is now at the bindery and will be distributed to our entire membership as a cloth-bound volume. I will not mention the titles of the monographs in preparation since such mention would necessitate responses to literally hundreds of letters inquiring about their publication dates. The dates are difficult to define since committees writing monographs devote much more time to their preparation than they anticipate and are inclined to revise them to the ultimate of perfection and thereby postpone any publication date originally established.

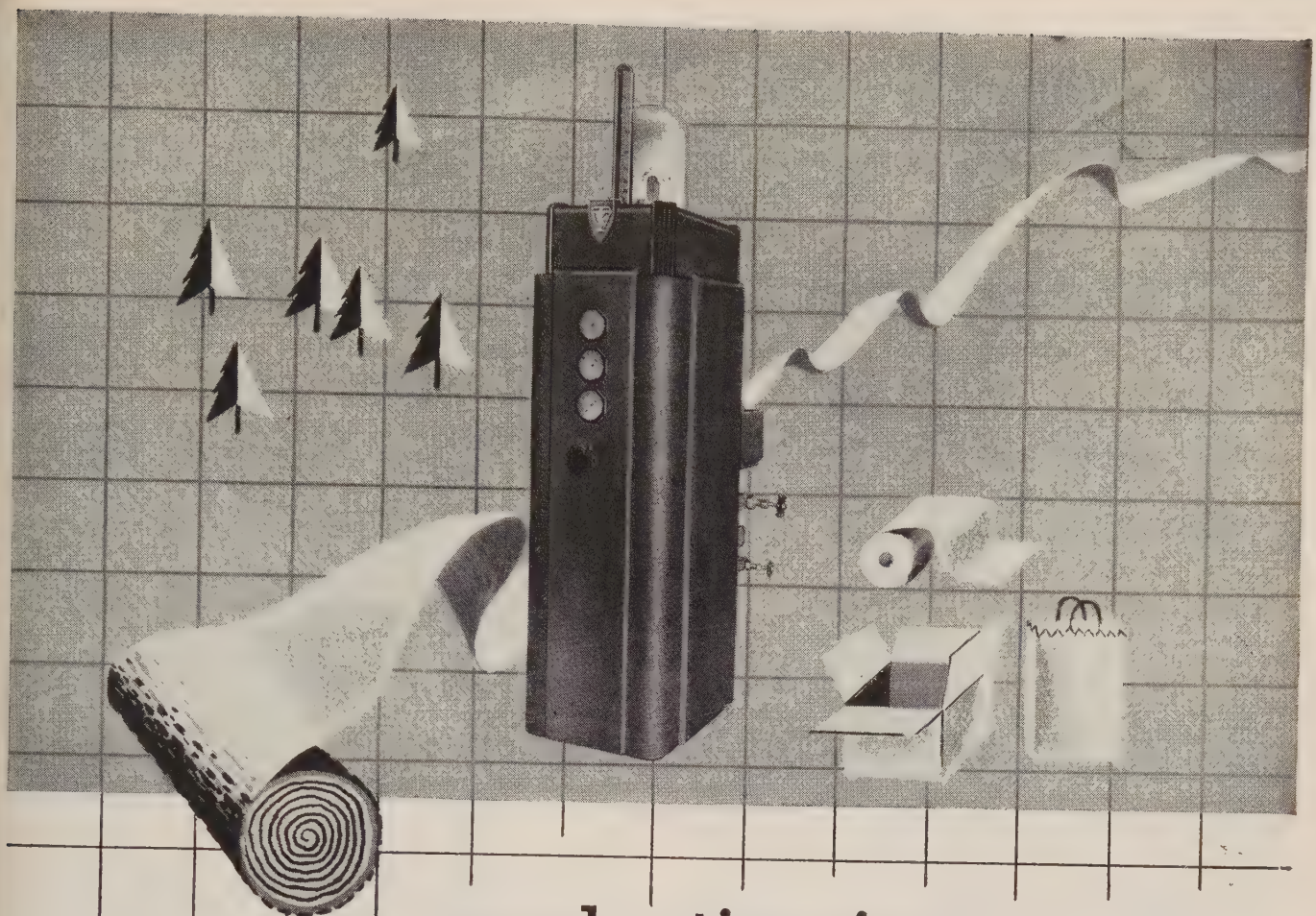
Other general publications are the Standards and Data Sheets, Bibliography of Paper Making and U. S. Patents, already mentioned, and Special Reports on Manufacturing Problems which are generally based on committee surveys and are not distributed to the entire membership but only to individuals who cooperate in their preparation and to the corporate members of the Association most of which cooperate to an excellent extent. The details concerning the membership and activities of the Association are issued annually in the TAPPI Year Book.

I would not want to end this brief sketch of the Technical Association in action without mention of the work of the Research Appropriations Committee. This is a group of carefully selected individuals whose experience enables them to evaluate the importance of any requests that are made by Association committees for funds to finance research projects. A considerable amount of publicity has been given in the recent issues of *Tappi* to the details of the many research project requests that have been acted upon by the committee.

During the past few years the Association has released rather sizable appropriations to encourage committees to deal with the improvement function of pulp and papermaking. In 1952 and 1953 the Association has made available an amount of $60,000 annually to be used for projects approved by the Research Appropriations Committee. Although the requests have not used up these available funds they have spurred a number of committees to define and organize projects that merited approval.

In some cases the projects have had merit although they were not considered to fall in the field recognized as research. In such cases some of these projects have been referred to the TAPPI Executive Committee for review and if considered to be proper were approved and financed. You are urged to read the report of the distribution of funds for research projects covering several years which appears in the October issue of *Tappi*.

In responding to Mr. Aronovsky's request to let you know something about the services of the Association to the strawboard industry I have limited my remarks to a review of what TAPPI is, how it operates, and some of the things that it has accomplished. It can almost be said that its 6000 members and its 160 committees and subcommittees are all established in business to assist the strawboard industry in the solution of its common problems, its efforts to minimize manufacturing costs and to produce products that will make life healthier and happier for your fellow men.



production increased up to 15 tons per day...

. . . with W & T chlorination equipment

A Southern mill had been having trouble with paper breaks attributable to the presence of slime in their white water. Despite continued efforts to control them slime breaks were running 60 to 80 per week, resulting in a time loss of 10 to 14 hours per week, and an average production loss of 15 tons per day! It was then that the W&T man was called in. Where and how to apply the proper treatment was determined, the costly methods were discontinued, and W&T chlorination was installed.

During the first 3 days of chlorination the mill recorded only 1 slime break and 2 minutes of lost time.

During the next 3 days there were 4 breaks and 17 minutes of lost time.

During the next 25 days there were no breaks attributable to slime!

. . . Within a week there were no production losses caused by slime! Performance such as that is typical of what your W&T representative can do for you.

If you have a production problem attributable to impure water, it would pay you to write or call him now.

WALLACE & TIERNAN
COMPANY, INC.
CHLORINE AND CHEMICAL CONTROL EQUIPMENT
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I-42

The conduct of the conference consisted of a round-table discussion of the "Properties of Strawboard Corrugating" and "Crush Resistance and Other Strength Properties of Strawboard." The questions that were discussed follow. (A complete report of the conference will be published in a later issue of *Tappi.*)

1. What is crush resistance of board and how is it measured? What is "ring" crush, "flat" crush?
2. In ring crush, what are the advantages or disadvantages of the $^1/_2$, $^3/_4$, and 2-in. diameter rings?
3. In flat crush, what are the advantages or disadvantages of the singleflute and multiflute samples? What are the advantages or disadvantages of single-faced or double-faced corrugated samples?
4. What is the correlation, if any, between ring-crush and flat-crush values for any particular sample of board?
5. Is there any correlation between ring crush and/or flat crush and the other strength properties of the board, such as Mullen, tensile, and tear?
6. Is there any correlation between crush resistance, i.e., ring crush, flat crush, of the corrugated board with the crush resistance of the complete box in stacking?
7. What is the industry's experience with the Concora tester? Is it the best and most reliable tool for flat-crush testing and how does it compare with the single fluter, from that standpoint?
8. Is it possible or desirable for the board industry, particularly the strawboard industry, to standardize on one test, ring crush or flat crush, as a measure of the crush resistance of the corrugating board or paper and/or the completed corrugated box? Do you think that this could be accomplished by coordinated round-robin testing within the mills of the strawboard industry?
9. Which one of the following straw cooks gives the highest resistance to flat crush: (a) lime and soda ash; (b) caustic soda; (c) lime and sodium sulphite, (d) caustic soda and sodium sulphite; (e) lime, soda ash, and caustic soda?
10. What kind of equipment is being used or is most suitable to break up tough and stringy cooked straw before refining?
11. Does washing of straw in beaters have any bearing on crush resistance of the resulting pulp?
12. Is better fiber obtained with lower power by refining straw pulp with high-speed refiners and disk refiners than with jordans? Which type of refining produces the highest crush resistance, jordans, disk refiners, or a combination of both?
13. What control tests are being made on the refined straw pulp and the finished stock with wastepaper furnish?
14. What is the effect of dirt and nonfibrous particles in the pulp upon flat crush and bursting strength of the strawboard sheet? Will removal of these extraneous materials by means of Centri-Cleaners, Dirtecs, Vortraps, and other pulp cleaners improve flat crush and other strength properties of the resulting sheet?
15. What advantage in flat crush occurs with high-strength properties across the grain of the sheet, and does the fourdrinier give this better than the multicylinder machine?
16. Has any mill studied the relationship of machine direction and cross-machine direction stiffness to establish to what degree, if any, the relationship plays a part in the ultimate flat crush of double-faced board?
17. What can be done to a strawboard sheet to maintain high crush resistance in a refrigeration carton?
18. What is the relationship between relative humidity in the paper mill or corrugating plant and crush resistance of the strawboard sheet? What is the relationship between the moisture content of the sheet and its crush resistance?
19. What chemicals have been applied to the strawboard sheet in the drier section or calender stacks, and with what success in creasing the crush resistance of the sheet?
20. Are figures available showing the relationship between the weight of strawboard and its crush resistance?
21. To obtain flat crush tests of over 40 p.s.i. on A-flute board, is it necessary to accomplish this by special corrugating operations?
22. What has been or can be done on corrugators to help increase the crush resistance of the strawboard sheet?
23. In the present strawboard mills, which units offer the most immediate promise of success in increasing crush resistance of strawboard corrugating, the straw pulp preparation plant or the paper mill?

Third Corrugated Containers Conference

The Third Annual Corrugated Containers Conference of the Technical Association of the Pulp and Paper Industry was held on Oct. 15–16, 1953, at the Hotel Statler, New York, N. Y. General chairman of the conference was K. W. Max, Robert Gair Co., New York, N. Y. Mr. Max was assisted in arranging the conference by a subcommittee consisting of E. A. Taub, Gibraltar Corrugated Paper Co., North Bergen, N. J.; W. W. Fitzhugh, Jr., Wm. W. Fitzhugh, Inc., Brooklyn, N. Y.; T. J. Gross, Union Bag & Paper Corp., New York, N. Y., and J. P. Greiveldinger, Robert Gair Co., New York, N.Y.

The conference was attended by 188 people from 18 different states, 15 from Canada, and one from Germany, making a total attendance of 204.

Thursday, October 15, was devoted to technical sessions in the morning and afternoon, following which a reception was enjoyed by all present, courtesy of the New York Printing Ink Makers' Association. After the reception a group dinner was held in the Statler ballroom, where those present were entertained by "Doc" Sims, well-known after-dinner speaker.

On Friday, October 16, chartered busses took the participants on a tour of corrugating plants in New Jersey. Plants visited were: Allcraft Container Corp., Harrison, N. J., Gibraltar Corrugated Paper Co., North Bergen, N. J., and Robert Gair Co., Teterboro, N. J.

Brief abstracts of the papers presented are given below. The full text of all papers along with the questions and answers that followed each paper will be published in a later issue of *Tappi.* The chairman of the morning session was E. A. Taub; of the afternoon session, W. W. Fitzhugh.

The Relationship of Printing on Corrugated Boxes to Advertising and Sales, by F. A. Fitzsimmons, Jas. H. Matthews & Co.

The value of a corrugated shipping container as an advertising medium was discussed in comparison to other media which fall into a more accepted advertising pattern. The value of printing on a supplier's container as a class of "reminder" advertising was discussed. The necessity for customers to keep their markets alive by fresh new designs with attractive color art work was described.

The need for close cooperation among the customer, the boxmaker, and the boxmaker's suppliers was emphasized from the standpoint of advertising principles. Particular coverage was given to the requirements of printing dies for fulfilling the advertising function of printed containers.

General information describing the design, procurement, specifications, use, maintenance, and storage of printing dies was presented from the standpoint of the die maker as suggestions to the boxmaker.

Future Printer-Slotter Design and Developments, by E. B. Seeger, S. M. Langston Co.

Specific discussion on the subject of ink foundations was presented from the standpoint of changes necessary to handle extremely viscous inks and to make more rapid and accurate foundation blade adjustments. Consideration was given to developments to reduce setup time and fountain wash-up time.

Aniline inks and the necessary press design requirements were given consideration. Means for over-all coloring of liner board with aniline inks on the printer-slotter were discussed as an alternative to the more expensive use of colored liner board.

Four-color printing was given consideration from the standpoint of present-day methods. A means to handle four-color work by modifying existing printer-slotters was described. The difficulties in developing a four-color press were discussed.

Printing Inks for Corrugated Containers, by W. E. Montoux, Sinclair & Valentine Co.

The three types of inks currently in use in the corugated field were described in relation to the requirements necessary for good press operation. This description covered briefly developments in the field of pigments, the relation of pigment properties to their use, and use of drying oils and resins in cor-

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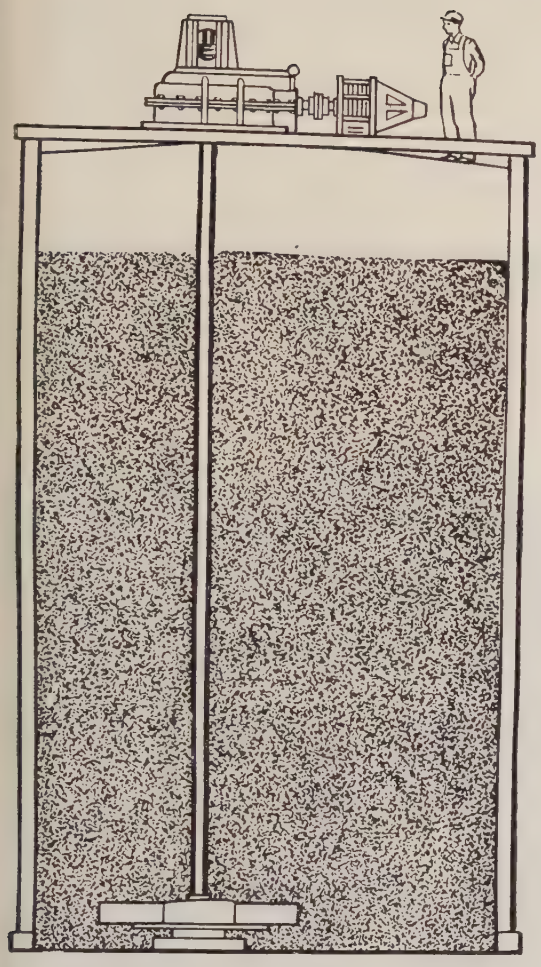

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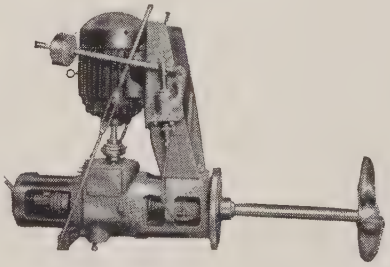

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rugated inks and the development of specially prepared vehicles for the production of improved inks for the corrugated printer. Advancements being made in the field of scuff resistance were described.

A review of some of the ideas and approaches currently under consideration for future development was offered. Several new types of ink such as the daylight fluorescent type were discussed. Raw materials not heretofore available have widened the scope of the ink manufacture and these materials were described. Some of the instruments used to control ink quality and uniformity were described.

Scheduling, Setup and Make-Ready, and Press Adjustments, by Stanley Baughman, Container Corp. of America

In scheduling work in the pressroom it is always necessary to strive toward (1) running the maximum number of impressions with a minimum amount of downtime and (2) to avoid congestion in the storage area behind the presses. A discussion of the problems created by the necessity of disturbing production by the processing of rush orders was presented. Implications arising out of consideration for ink type and color, joint style and special setup for such things as hand holes, punch holes, two out, and skip feed were given as they affect scheduling the setup procedures.

A description was given for the proper setup procedure when such factors as score alignment, impression depth, slotter head setting, slitter head setting, hopper adjustment, and fountain blade adjustment are given consideration. Constant adjustment must be made through out the run as the various checks on quality will dictate. Considerable detail was given on the proper procedures for correcting various difficulties.

Press Operation, Maintenance, and Control, by Howard Rosen, National Container Corp.

As the press operation is a critical phase in the entire operation of a corrugated box plant, it is necessary to follow a rigid maintenance schedule and quality control program to insure proper box fabrication.

The maintenance program involves the care of ink rollers, ink flow adjusters, bearings, shafts, printing drums, slotting heads, scores, and trim knives. Through a planned program of oiling and greasing working parts, periodically changing slotter heads and trim knives, proper care of ink rollers, and with a special wash-up crew, a longer press life can be insured. To round up the program, weekly meetings are held with a maintenance panel consisting of the master mechanic, chief engineer, and plant electrician.

The quality phase of the program involves a set procedure of making quality checks. Consideration must be given to changing disks when they are worn or excessively hard. Precautions should be taken against excessive feed roller damage, pull roller damage, and printing impression. The system of checking these damages with the aid of a caliper is important. It is essential to guard against poor print jobs resulting from the use of bad dies and improper inks.

The Effect of Printing Upon the Functional Properties of Corrugated Fiberboard Boxes, by A. W. Hoffman, Container Laboratories, Inc.

To what extent is the primary purpose of a box—retention and protection of contents during handling, storage, and transportation—impaired as a result of printing? Although statistical data on deterioration are not easily analyzed because of the multiplicity of variables affecting the complex inner relationship between the container, the interior fittings and contents, some basic information is available and data were presented in the light of generalities. A review of thousands of test results has led to the establishment of modifying factors used to compare the compressive resistance of printed to unprinted containers. The relationship of caliper on printed and unprinted areas to flat crush resistance was analyzed and implications on the functional characteristics were discussed.

Shall We Accept It?, by Paul F. Smith, Scott Paper Co.

The customer's requirements for attractive art work and color were compared to his need for adequate product protection. The desires of a customer to use his container as an advertisement were analyzed and his justification for placing the responsibility for performance on the manufacturer was brought to light. What constitutes acceptable printing and acceptable performance was described. The shortcomings and good qualities were discussed.

The dinner group at the Third Corrugated Container Conference, New York, N. Y., Oct. 15–16, 1953

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A general contract for the construction of an integrated newsprint and sulphate pulp mill at Calhoun, Tenn., was let here yesterday by Bowaters Southern Paper Corporation to Fraser, Brace and Co., New York; Turner Construction Co., New York, and Roane Anderson of Tennessee, acting jointly.

The contract was let by Bowaters' representatives in the office of J. E. Sirrine Co., consulting engineers to Bowaters Southern Paper Corporation. The Sirrine firm was also engineers for the Coosa River co-operative newsprint mill in Alabama which is now in production.

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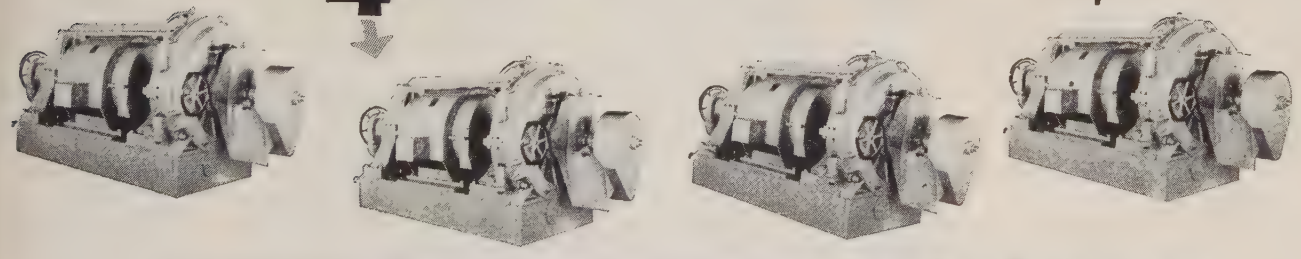

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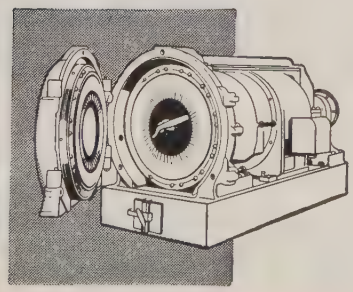

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PERSONAL MENTION

Items About New and Old Tappimen

New TAPPI Members

Martin J. Auchter, Vice-President in Charge of Manufacturing, Charmin Paper Mills, Inc., Green Bay, Wis., a 1932 graduate of Marquette University.

Dean W. Balkema, Technical Representative, Price & Pierce, Ltd., New York, N. Y., a 1940 graduate of the University of Washington.

John Bentley, Works Chemist, East Lancashire Paper Mill Co. Ltd., Radcliffe, near Manchester, England, a graduate of the Manchester College of Technology.

Burton A. Bittner, Power Plant Engineer, S. D. Warren Co., Cumberland Mills, Me.

W. Ross Bowen, Salesman, R. T. Vanderbilt Co., Inc., New York, N. Y., a 1948 graduate of Massachusetts Institute of Technology.

Cornelius Callahan, III, Technical Director, Container Corp. of America, Wabash, Ind., a 1942 graduate of Purdue University.

Gerald E. Camp, Assistant Chief Chemist, St. Regis Paper Co., Jacksonville, Fla., a 1949 graduate of Mercer University.

George T. Clayton, Head of Engineering, Moore & White Co., Philadelphia, Pa. Attended the University of Manchester, England.

Earle H. Clifford, Jr., Physicist, Dixie Cup Co., Easton, Pa., a 1950 graduate of the University of Maine.

Victor D. Davis, Sr., Power Superintendent, The Brown Paper Mill Co., Inc., Monroe, La.

Robert L. Duke, Section Engineer, Industry Application Dept., Canadian Westinghouse Co. Ltd., Hamilton, Ont., Canada, a 1941 graduate of the University of British Columbia.

J. Frank Ferrell, Technical Assistant to Manufacturing Superintendent, Ecusta Paper Corp., Pisgah Forest, N. C., a 1939 graduate of the University of North Carolina.

John D. Fisher, Plant Engineer, Beloit Box Board Co., Beloit, Wis., a 1941 graduate of Purdue University.

Harry E. Fox, Jr., Manager, Engineering Dept., New York & Pennsylvania Co., Inc., Lock Haven, Pa., a 1928 graduate of Pennsylvania State College.

Robert A. Flick, Process Engineer, Brunswick Pulp & Paper Co., Brunswick, Ga., a 1948 graduate of Georgia Institute of Technology.

Earl G. Fugetts, Sales Engineer, Dowell, Inc., Richmond, Va., a 1949 graduate of the University of Houston.

Armand J. Gauthier, Research and Development Chemist, McLaurin-Jones Co., Brookfield, Mass., a 1938 graduate of Clark University.

Samuel H. Greenwood, Sales Engineer, Flynn & Emrich Co., Baltimore, Md., a 1947 graduate of the University of Maryland.

Enrique R. Gremler, Head Chemist, Paper Mill, W. R. Grace & Co., Paramonga, Peru, a 1950 graduate of New York State College of Forestry.

Donald C. Harper, Plant Superintendent, Hygrade Containers Ltd., London, Ont., Canada.

Fred P. Hauck, Vice-President, Michigan Abrasive Co., Detroit, Mich., a 1927 graduate of New York University.

Hugo J. Hotz, Sr., Director, Technical Service and Development, Central Paper Div., S. D. Warren Co., Muskegon, Mich.

Francisco Torras Hostench, Technical Manager, J. y F. Torras Hostench S. A., Barcelona, Spain, a graduate of Ecole Francaise de Papeterie.

Walter B. Jacobs, Yeast Plant Superintendent, Charmin Paper Mills, Inc., Green Bay, Wis.

Edwin V. Kemp, Assistant Director of Laboratories, The Bauer Bros. Co., Springfield, Ohio, a 1947 graduate of Polytechnic Institute of Brooklyn.

Robert E. Kissel, General Superintendent, Charmin Paper Mills, Inc., Green Bay, Wis., a 1930 graduate of the University of Pennsylvania, Wharton School.

Edward Law, Jr., Mill Superintendent, Waldorf Paper Products Co., St. Paul, Minn., a 1948 graduate of the University of Michigan.

Walter J. LeBel, Project Engineer, Central Paper Div., S. D. Warren Co., Muskegon, Mich., a 1950 graduate of the University of Maine.

Trygve C. Luken, Student, New York State College of Forestry, Syracuse, N. Y.

Morris Malmed, Plant Manager, A & P Corrugated Box Corp., Lowell, Mass.

Cecil J. Mathieson, Assistant Chief Chemist, N. Z. Forest Products Ltd., Auckland, N. Z., a 1935 graduate of Auckland University.

Raymond W. McCormick, Paper Mill Superintendent, National Container Corp., Jacksonville, Fla.

Rex B. Morris, Chemical Engineer, Paper Development, Crown Zellerbach Corp., Camas, Wash., a 1950 graduate of the University of Washington.

Robert D. Morton, Assistant to Chief Chemist, Shellmar-Betner Flexible Packaging Div., Continental Can Co., Richmond, Va.

Noburu Nawa, Manager, Honshu Paper Mfg. Co., Iwabucki Mill, Fujikawa-cho, Ihara, Shizuoka, Japan, a 1926 graduate of Tokyo University.

Leonard C. Nevin, Chief Engineer, Chemipulp Process, Inc., Watertown, N. Y., a 1926 graduate of Clarkson College of Technology.

M. Nozaki, Plant Manager, Mitsubishi Rayon Co., Chuoku, Tokyo, Japan, a 1924 graduate of Hiroshima Technical College.

Miguel A. Ramirez P., Student, Mexico D. F., Mexico.

Yasuo Oono, Assistant Professor, Tokyo University of Agriculture and Technology, Faculty of Textile Industry, Tokyo, Japan, a 1943 graduate of Tokyo Institute of Technology.

Robert V. Parkison, New Product Development Group, Spencer Chemical Co., Kansas City, Mo., a 1952 graduate of The Institute of Paper Chemistry with a Ph.D. degree.

Erasmus A. Randich, Development Engineer, United Engineering & Foundry Co., Pittsburgh, Pa., a 1942 graduate of Drexel Institute of Technology.

George E. Reynolds, Mechanical Engineer, Nekoosa-Edwards Paper Co., Port Edwards, Wis., a 1937 graduate of Tri-State College.

Howard J. Richardson, Beater Room Supervisor, Merrimac Paper Co., Inc., Lawrence, Mass. Attended Lowell Technical Institute.

Pentti O. Routalahti, Superintendent of Paper Mill, The Nokia Co., Nokia, Finland, a 1949 graduate of the Technical University, Helsinki.

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Cleveland, 15.....2238 Midland Building
Detroit, 26.....1548 Lafayette Building
Havanna.....402 Abreu Building
Houston, 2.....2156 National Standard Building
Los Angeles, 17....1550 General Petroleum Building
New York, 6.....3324—165 Broadway Building
Philadelphia, 3...1642—1700 Walnut Street Building
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San Francisco, 4.....1538—200 Bush Street
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Calvin F. Schlessman, Junior Engineer, Union Bag & Paper Corp., Savannah, Ga., a 1953 graduate of Carnegie Institute of Technology.

Richard W. School, General Superintendent, Pulp Mill, Champion Paper & Fibre Co., Canton, N. C., a 1922 graduate of the University of Michigan.

Ray E. Smith, Assistant Supervisory Chemist, Oswego Falls-Sealright Corp., Fulton, N. Y., a 1951 graduate of the University of Maine.

Antanas Stonis, Chief of Laboratory, Nitro Quimica Brasileira, Sao Paulo, Brazil, a 1940 graduate of the University at Vilnius.

Richard W. Sweet, Jr., Technical Assistant, Nucel Centralabs, Syracuse, N. Y. Attended Colgate University.

Toshio Tachibana, Technical Adviser, Nitto Paper Mfg. Co. Ltd., Marunouchi, Chiyodaku, Tokyo, Japan, a 1924 graduate of Yokohama Technical College.

Arno E. Teschendorf, Chemical Engineer, Rhinelander Paper Co., Rhinelander, Wis., a 1950 graduate of the University of Wisconsin.

Benjamin J. Trevelyan, Director of Research, Fraser Cos. Ltd., Edmundton, N. B., Canada, a 1944 graduate of MacMaster University with a Ph.D. degree from McGill University in 1951.

Paul T. Tunner, Manager, Lemanco Investments Ltd., Montreal, P. Q., Canada, a 1927 graduate of the University of Trade and Commerce, Vienna.

Earl M. Young, Jr., Chemist, Rohm & Haas Co., Philadelphia, Pa., a 1953 graduate of Drexel Institute of Technology.

Thomas T. Zayatz, Superintendent, Doeskin Products, Inc., Mt. Tom, Mass.

Piotr Zenczak, Consulting Engineer, Forest Products, Seattle, Wash., a 1936 graduate of Polytechnic Lwow.

TAPPI Notes

Members of the Technical Association of the Pulp and Paper Industry are urged to check their listings in the TAPPI 1953 Year Book. If the listing should be changed when published in the 1954 Year Book please advise the Secretary at 155 E. 44th St., New York 17, N. Y.

R. S. Aries, president of R. S. Aries & Associates, has moved his New York City office to 270 Park Ave., New York, N. Y.

Frederick A. Aflenzer, formerly of the Forest Products Laboratory, is now Technical Assistant at the University of Technology, Graz, Austria.

Carl A. Anderson, formerly of Hollingsworth & Whitney Co., is now President of Sonnset Paper Converting Co., Fairfield, Me.

Arthur Biddle, formerly of Benjamin C. Betner Co., is now with Shellmar Betner Flexible Packaging Div., Continental Can Co., Richmond, Va.

Peter Calott, technical salesman for the American Cyanamid Co., has been transferred from St. Louis, Mo., to Chicago, Ill.

Edgar H. Carpenter, formerly of B. F. Goodrich Co., is now Technical Director of the Weston Paper Manufacturing Co., Terre Haute, Ind.

Philip A. Cerasoli is now Director of Quality Control for W. C. Hamilton & Sons, Miquon, Pa.

E. A. Charleton is now Vice-President and General Manager of the H. K. Ferguson Co., of Canada, Ltd., Montreal, P. Q.

Sidney M. Collier, formerly of MacMillan & Bloedel Ltd., is now General Sales Manager of Metal Sales Co., Inc., Kirkland, Wash.

Douglas A. Crocker, formerly of the Tissie Association, is now a Paper Products Consultant, 86 Eastway, Mt. Kisco, N. Y.

Clarence B. Davies, formerly of E. B. Eddy Co., Ltd., is now Mill Manager of Irving Pulp & Paper Ltd., Fairville, N. B.

Arthur L. De Spain, formerly of Chas. T. Main, Inc., is now Project Engineer for Parsons & Whittemore, Inc., New York, N. Y.

Jean E. A. Du Pont, Papermaking Consultant, has moved his office from San Sebastian, Spain, to Brussels, Belgium.

Leon R. Eeman, formerly of the Brompton Pulp & Paper Co., is now Chemist for the St. Lawrence Corp., Ltd., Red Rock, Ont.

J. A. Fincken is now Plant Manager of Paper Products Mfg. Co., Swarthmore, Pa.

Donald J. Goodman is now General Superintendent in charge of the Oglesby, Smith and Sorg mills of the Sorg Paper Co., Middletown, Ohio.

Carl A. Gyllenhoff, Consultant for Elof Hansson Co., has moved his office from Sao Paulo, Brazil, to Gothenberg, Sweden.

Bernard L. Hamilton, formerly of the St. Regis Paper Co., is now Chemist for Hollingsworth & Vose Co., East Walpole, Mass.

Ralph E. Hayes, formerly of the Manitoba Paper Co., is now Assistant Production Manager for the Abitibi Power & Paper Co., Ltd., Toronto, Ont.

George B. Hills, Jr. is now Executive Assistant for Powell River Co. Ltd., Vancouver, B. C.

George E. Hocking is now Staff Engineer in the Chemical Products Section of Socony-Vacuum Oil Co., Inc., New York, N. Y.

Charles M. Howell is now Professor of Paper Technology in the Chemical Engineering Dept., University of Maine, Orono, Me.

Everett P. Ingalls, Jr. is now Assistant Production Manager of the Central Paper Co. Div., S. D. Warren Co., Muskegon, Mich.

Martin Jaffe is now Sales Representative of the Western Waxed Paper Div., Crown Zellerbach Corp., New York, having been transferred from San Leandro, Calif.

Nils F. Janson, formerly of the U. S. Navy, is now Chief Engineer of the West Virginia Pulp & Paper Co., Mechanicville, N. Y.

Norwood H. Kenney, Jr., formerly of the Fram Corp., is now Assistant Professor in the Dept. of Paper Engineering, Lowell Technological Institute, Lowell, Mass.

Fred A. Leser, Jr., Salesman for Samuel M. Langston Co., has been transferred from Camden, N. J., to Chicago, Ill.

W. B. Lincoln, Jr. is now Assistant Vice-President in Charge of Technical Service of the Inland Container Corp., Indianapolis, Ind.

Albert E. Logan, Section Head, Heat and Power Engineering, Buckeye Cellulose Corp., has been transferred from Cincinnati, Ohio, to Foley, Fla.

John M. McClure, formerly of S. D. Warren Co., is now Chemical Engineer for Potlatch Forests, Inc., Pomona, Calif.

Leo F. McDonnell, formerly of the Minnesota & Ontario Paper Co., is now a student at The Institute of Paper Chemistry, Appleton, Wis.

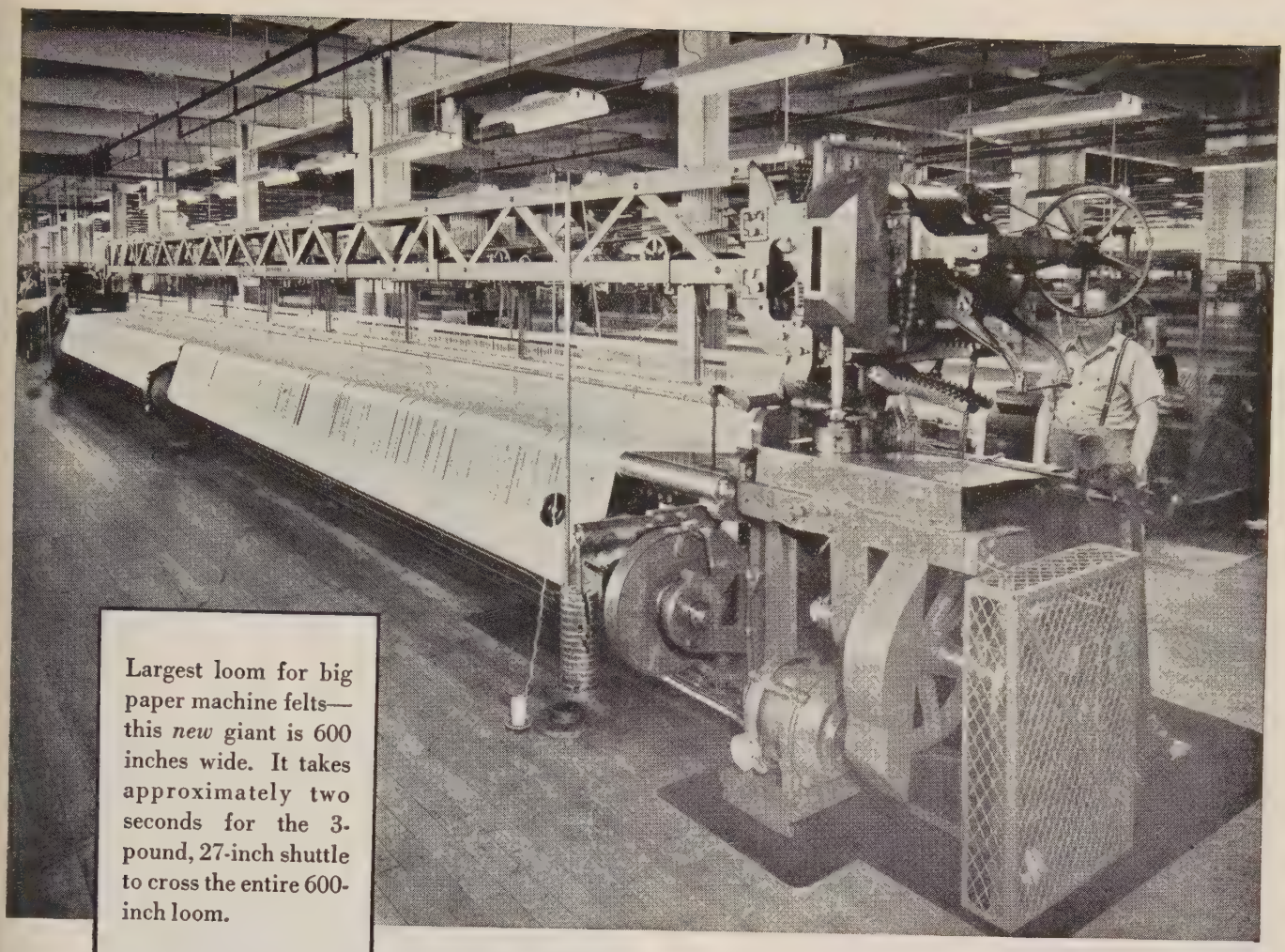
W. A. McKenzie, Director of Engineering for the Simpson Logging Co., has been transferred from Shelton, Wash., to Seattle, Wash.

Edward A. Mason, formerly Professor of Chemical Engineering at the Massachusetts Institute of Technology, is now Senior Engineer for Ionics, Inc., Cambridge, Mass.

Benjamin E. Natwick, Western Representative of the Appleton Wire Works, has moved from Camas, Wash., to 600 S. Andresen Rd., Vancouver, Wash.

L. D. Nicolson, formerly of the D of C Paper Mills, Inc., is now Plant Manager of Lestershire Spool & Mfg. Div., National Vulcanized Fibre Co., Johnson City, N. Y.

James A. Pettigrew, Engineer for Potlatch Forests, Inc., has been transferred from Lewiston, Idaho, to Pomona, Calif.



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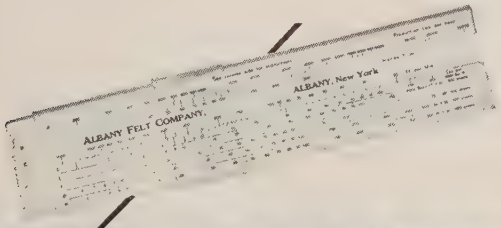

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Warren R. Price, Consulting Chemical Engineer, is now located at 4975 Dobson St., Skokie, Ill.

Oscar Rolls is now Technical Director of A/S Greaker Cellulosefabrik, Greaker, Norway.

Henry A. Rothchild, Assistant to the Vice-President of the Kimberly-Clark Corp., has recently completed 40 years of service with K-C.

Frederick B. Schelhorn, formerly with the Brown Co., is now Superintendent of the Technical Dept., National Container Corp., Valdosta, Ga.

J. B. Schields, formerly of Benjamin C. Betner Co., is now with the Shellmar-Betner Flexible Packaging Div., Continental Can Co., Devon, Pa.

Henry A. Schmitz, Retired Sales Engineer of the A. O. Smith Corp., is now Sales Representative for U. S. Hoffman Co., Milwaukee, Wis.

H. W. Stevens, formerly of Benjamin C. Betner Co., is now with the Shellmar-Betner Flexible Packaging Div., Continental Can Co., Devon, Pa.

Otto C. Sylwan, formerly of Herre Fabrikker A/S in Norway, is now the Expert on Sulphate Pulp and Kraft Paper for the United Nations, Belgrade, Yugoslavia.

William R. Talley is now Pulp Mill Superintendent for the Macon Kraft Co., Macon, Ga.

Forestier Walker, formerly of Fraser Companies, Ltd., is now in the Research Dept. of American Enka Corp., Asheville, N. C.

Marshall O. Walker, formerly of Michigan Abrasives Co., is now in the Research Dept., Electro Refractories & Abrasives Corp., Buffalo, N. Y.

Blanchard D. Warren is now Pacific Manager of Bird Machine Co., Portland, Ore.

Ernst A. Wendt is now Paper Mill Superintendent of the Marathon Corp., Oswego, N. Y., having been transferred from Menasha, Wis.

C. J. Witowski, formerly of the Ancram Paper Mills, is now in the Project Development Dept., Parsons & Whittemore, Inc., New York, N. Y.

* * *

Lars Mikander has succeeded Rolf Christiansen as the official corporate representative of A. Ahlstrom OY, Warkaus Finland.

Industry Notes

Production

Paper and board production during July amounted to 2,042,196 tons, according to the Bureau of the Census, Dept. of Commerce. This is about a 16% increase over the tonnage of 1,761,982 produced in July a year ago. The output of paperboard grades during this month, amounting to 929,621 tons, reflected an increase of 20% over the production of 774,960 tons reported during July, 1952. Paper production, amounting to 872,285 tons, registered a 14% increase from the 765,733 tons produced in July a year ago.

Pulpwood receipts at the pulp mills during July amounted to 2,431,825 cords, with consumption at 2,175,903 cords. Month-end inventories increased about 5% to 5,200,679 cords.

Receipts of fibrous materials, other than wood pulp, totaled 811,257 tons. 730,685 tons were consumed and inventories showed a seasonal rise from 835,595 tons to 914,534 tons at month's end. Receipts of wastepaper at 656,308 tons were greater than consumption which amounted to 633,320 tons. End-of-month inventories of wastepaper, at the mills, accordingly increased to 480,552 tons.

Wood pulp production during July amounted to 1,360,332 tons as compared to 1,192,025 tons produced in July a year ago.

Wood pulp inventories at the end of July at the paper and board mills amounted to 533,569 tons, showing a slight decline during the month. Month-end stocks at the pulp mills were 154,457 tons, about 10% below the 172,295 tons reported at the end of May.

Production (Thousands of Tons) in Second Quarter (1953)

All grades, total	6790
Paper, total	2871
Newsprint	265
Groundwood (uncoated)	197
Machine-coated	293
Book (uncoated)	416
Fine, total	333
Rag	33
Chemical wood and other	300
Coarse, total	859
Unbleached kraft	633
Other	226
Special industrial	107
Sanitary	309
Tissue	59
Absorbent	33
Paperboard, total	3136
Container board	1716
Bending board	892
Folding boxboard	614
Special food board	233
Other	45
Nonbending board	232
Setup boxboard	187
Other	45
Cardboard	39
Miscellaneous	257
Wet machine board	42
Construction paper and board	741
Construction paper	365
Construction board	376

Pulpwood

Consumption of pulpwood in the first half of 1953 was at the highest level in history, totaling over 14 million cords and registering an increase of 4.2 and 6.4% respectively, over the same periods of 1952 and 1951. Supplies continue adequate with no problems anticipated for the ensuing several months. National inventories are down nearly 4% below a year ago, with substantial reduction in the Appalachian, Lake, and Northeast regions, where burdensome stocks of old pulpwood had been accumulated during the previous 2 years.

The renewed interest in the pulpwood procurement in larger volume is reported to have strengthened prices on market pulpwood in many areas. A larger Winter cut of pulpwood in the northern states and in Canada is expected again this year, following the lull in the 1942–53 season.

Wood Pulp

Supplies of wood pulp continued adequate to meet the recordbreaking consumption of 9,713,000 tons in the first 6 months of 1953. Supplementing the peak domestic half-year output of 8,781,000 tons were imports totaling 1,093,000 tons. Imports were up about 170,000 tons, or nearly 19%, over the first half of 1952. Exports, on the other hand, dropped nearly 80,000 tons, or 55% less than a year ago.

Paper and Board

Comparing the first 6 months of 1953 production of paper and board with the same period of 1952 can be misleading unless the situation of a year ago is understood. With respect to most grades of paper, demand and production were running at a high level in early 1952 since the inventory liquidation cycle in paper did not take place until the second and third quarters of last year. On the other hand, the inventory liquidation cycle in paperboard started in the last half of 1951 and carried through the first half of 1952. During this period paperboard output was at a slackened level.

With this in mind, it will be observed that total paper and

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board production of all grades in the first 6 months of 1953 was 9.8% above a year ago. Paper production recorded no change, but paperboard output was up 19.5%, wet machine board up 18.8% and construction paper and board up 13.7%.

Wastepaper

Wastepaper consumption in the first half of 1953, amounting to 4,348,000 tons, increased 17.3% over the 1952 period, closely following the pattern in paperboard production. Receipts of wastepaper were approximately equal to consumption during the first 6 months, with inventories remaining relatively steady during this period. However, compared to a year ago, June wastepaper inventories were down 76,000 tons, or about 14%. It will be recalled that during the first half of 1952 there was an accumulation of wastepaper inventories when paperboard production was at a lower level and on a downward trend.

The wastepaper industry, which supplies the consumers with paperstock, has before it the biggest task since the fourth quarter of 1950, when the mills consumed 2,224,000 tons of wastepaper; the first quarter of 1951, when 2,508,000 tons were consumed, or the second quarter of 1951, when 2,568,000 tons of wastepaper went into the beaters. Substantial improvements have been made in the methods of packing wastepaper since the Korean war started in the midyear of 1950, and the wastepaper industry is now capable of turning out better sorted, better packed paperstock than ever before.

The problem at present seems to be with the collections and with the carelessness on the part of some packers in properly sorting and packing the stock to meet the specific requirement of their customers. An increasing amount of wastepaper is being rejected by the mills. A maximum of efficiency in both collecting and packing is necessary now to provide the consumers with the quantities and the quality they require. More than adequate quantities of wastepaper are available for collection and, when properly processed, will find eager buyers.

Postwar Expansion

In the years following World War II, the paper and pulp industry launched a program of capital expenditures for new plants and equipment of a proportion never before approached. The volume of dollars spent in the expansion of fixed capital facilities by the paper and allied products industries for the period 1946–53 is estimated by the Dept. of Commerce to be 2.7 billion dollars, the preponderance of which presumably was expended by primary producers of paper and pulp.

In this industry, the expansion of facilities has varied widely among the various segments according to management's collective assessment of sales opportunities and prospective supply-demand relationships.

The accompanying table, showing the extent and distribution of the industry increases in capacity for the years 1946–53, and increases planned to become effective in 1954, illustrates the over-all results of this judgment.

It is clear from this tabulation that paperboard mills, as a result of their ability to expand old and develop new markets for their products, have experienced the greatest growth adding over 5 million tons to their capacity since 1946. Thus, the amount of capacity added in the past 7 years is estimated to be equal to about 65% of the capacity, and 80% of the production of such mills in 1939.

With regard to paper, total expansion has amounted to slightly more than three million tons. Wrapping and specialty papers manufacturers, adding 1,200,000 tons, and book and groundwood paper producers, adding 800,000 tons, registered the largest increases while fine paper mills, expanding their capacity by only 200,000 tons, showed the smallest increase. It is also of interest to note that the capacity of domestic mills to produce newsprint has enjoyed the largest relative growth and by 1954 they will be in a position to produce newsprint in a volume not equalled by United States mills in the past 25 years.

By the end of 1954, the largest relative increase for a single grade of pulp will be that of 206% for dissolving pulp. In terms of tons, however, the largest increase will have occurred in papermaking grades of sulphate pulp as the capacity to produce such pulp is increased by 6 million tons, equal to 60% of the total expansion in pulping capacity for the period under consideration.

Newsprint Study

A House subcommittee, a special unit of the House Judiciary Committee, has just completed a 3-year study of the newsprint industry. The group outlined a 25-point program to meet future newsprint needs of the country. Specific recommendations included the preparation by the Commerce Dept. of a blueprint for a newsprint industry in Alaska on a

Wood Pulp, Paper, and Paperboard: Changes in Productive Capacity, 1946–53, and Planned for 1954

	Thousand tons									*% Change, 1946–54*
	1946	*1947*	*1948*	*1949*	*1950*	*1951*	*1952*	*1953*	*1954*	
Paper										
Book and groundwood	2,830	3,233	3,372	3,375	3,425	3,485	3,549	3,577	3,603	+27.3
Fine	1,170	1,272	1,312	1,317	1,317	1,326	1,365	1,365	1,380	+17.9
Wrapping and specialty	3,250	3,239	3,504	3,711	3,713	3,798	3,946	4,421	4,431	+36.3
Tissue	1,150	1,184	1,322	1,334	1,370	1,409	1,444	1,464	1,498	+30.3
Absorbent	110	110	110	110	111	112	112	118	118	+7.3
Newsprint	850	823	893	924	1,033	1,052	1,059	1,093	1,310	+54.1
Building	1,160	1,329	1,389	1,389	1,389	1,389	1,389	1,389	1,389	+19.7
Total paper	10,520	11,190	11,902	12,160	12,358	12,571	12,864	13,427	13,729	+30.5
Board										
Building	1,050	1,147	1,318	1,318	1,421	1,421	1,450	1,560	1,600	+52.4
Paperboard	8,850	9,689	10,240	11,127	11,802	12,329	12,587	13,561	13,979	+58.0
Total board	9,900	10,836	11,558	12,445	13,223	13,750	14,037	15,121	15,579	
Total paper and board	20,420	22,026	23,460	24,605	25,581	26,321	26,901	28,548	29,308	+43.5
Wood Pulp										
Dissolving and special alpha	364	420	426	432	479	617	719	1,015	1,114	+206.0
Sulphite	2,544	2,471	2,553	2,549	2,571	2,609	2,648	2,634	2,643	+3.9
Sulphate	5,377	5,496	6,289	6,981	7,671	8,711	9,564	10,747	11,006	+104.7
Soda	494	505	541	555	540	461	472	478	478	−3.2
Groundwood	2,330	2,446	2,659	2,743	2,871	2,936	2,968	3,005	3,241	+39.1
Other	1,021	1,451	1,638	1,758	2,034	2,334	2,693	3,036	3,036	+197.4
Total wood pulp	12,130	12,789	14,106	15,018	16,166	17,668	19,064	20,915	21,518	+77.4

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self-sustaining basis, financed by private capital; further research by the industry to develop a successful method of deinking old newspaper; further studies to develop the use of hardwoods in making newsprint pulp; broadening research on bagasse so that it may be used for paper products other than newsprint; special studies by several Federal Agencies on investment and production costs, profit margins, and price structures; enactment of legislation to permit the duty-free import of newsprint made partially or entirely from bagasse; upward revision of the newsprint expansion goal set by the Office of Defense Mobilization, so that more new producers may get the benefit of accelerated tax amortization benefits; acceleration in the Agriculture Dept.'s forestry survey program, and United States technical assistance to Cuba and other sugar-producing countries abroad to develop bagasse newsprint production. The subcommittee also recommended the formation of an interagency committee to supervise and keep the program moving. The Departments of State, Commerce, Agriculture, and Interior and the Foreign Operations Administration would be represented on the committee.

N. H. Forest Tax

Forest land covers more than three quarters of New England, and the region's shipments of commercial products made of wood exceed one billion dollars annually. Nevertheless, output falls far short of the potential productive capacity of the forests. One of the obstacles to greater forest productivity is the typical taxation of forest property, which tends to encourage inferior management practices.

Many states in the nation have enacted legislation aimed at relieving forest property owners from inequitable taxation. With few exceptions these laws have provided inconsequential encouragement to improved forest management. The problem continues to attract the attention of legislative bodies.

Maine has provided fresh evidence of the general awareness that traditional methods of forest property taxation are obstacles to good forest management. Its legislative research committee recently reported on an analysis of forest land taxation in Maine. The committee concluded that existing methods of assessment of forest lands in a large portion of the state are contrary to sound public policy and suggested that the tax laws be revised to establish uniform methods of assessment *according to the productivity of the land.*

The committee expressed its opinion that the application of a yield or severance tax to timber, while highly desirable in theory, encounters difficulties in practice. The committee believed that such a tax might require an amendment to the Constitution in Maine. The outcome of the legislative committee's suggestions will be widely observed with interest.

New Hampshire's forest property taxation reform has been in effect since March 31, 1950. On Sept. 30, 1952, the forest yield tax had been in operation for two full years. The 1952 figures are not yet available, but the new law has had some opportunity to demonstrate its capacity to provide an incentive for improved forest management. The extent to which it contributes to better forest management will be the true measure of its success or failure.

New Hampshire's revised law imposes a tax of 10% on the value of timber at the time of cutting, but it grants an abatement of 30% of the tax if the cutting is certified as complying with good forest-conservation standards. The frequency with which abatements are earned is a direct measure of the extent of good forestry practice.

How is the law working out? The assessed stumpage value of the timber cut in New Hampshire during 1951 was $4.1 million. Seventy-five per cent of this value was taxed at the full 10% rate, but 25% qualified for the 30% abatement. This is estimated at more than double the compliance with good forestry practice in effect before the yield-tax system was adopted. State officials expect that qualification for abatement in 1952 will be even higher.

Evidence supports the view that the purpose of the law is being fulfilled in New Hampshire. The compliance of 25% of a year's cut with approved forestry standards is a substantial consideration. As more owners become aware of future timber values, better cutting methods and good forest management can be expected to become more general.

Perhaps the greatest difficulty foreseen by the Maine research committee arises from the potential loss of tax revenue some of the towns may incur under the new law. In New Hampshire, the law was based on the assumption that each individual town or city is entitled to receive at least the same tax income from its forest properties as it had received during recent years under the old law. It was obvious that this would not always be the case, and the law provided for reimbursement by the state of the towns' tax "losses."

By the end of 1951, the state had expended more than a half million dollars to reimburse 127 of the 232 towns and cities for tax revenues "lost" under the new law. Two thirds of this liability was incurred in 1950, when the towns lost their old revenue for the full year and collected the new taxes for only 6 months. On the other hand, 105 towns took in more tax money under the new law in 1951 than they would have under the old law. This was true of only 22 towns in 1950.

Eighty-two towns lost tax revenue in 1950 but collected an excess in 1951. Three of them did not request reimbursement. The other 79 have returned to the state almost $32,000 of the reimbusement payments they received for their 1950 losses, as the law requires. As 1952 began, 41 towns already had balances greater than their anticipated 1952 tax losses under the old law and 26 others had balances which partially offset expected 1952 losses.

The demand for reimbursements from the state will decline in time, but in any event it seems clear that the expenditure will prove to have been a good investment for the state. The new law has already broadened the use of good forestry practices. The greater forest productivity resulting from the realized and prospective improvement in forest management can add millions of dollars to the income of New Hampshire residents. The forests of New Hampshire offer one of the state's best opportunities for economic growth.

Other difficulties which arose with the enactment of the New Hampshire timber tax law, largely problems of administration, are clearing up as experience is gained. Positive benefits are becoming steadily more evident. Tax evasions resulting from incomplete tax rolls and other loopholes have been reduced. The new law eliminates the inequities that result from differing and changing assessments on similar properties in neighboring communities. Forest owners now pay taxes in proportion to the productive capacity of their forest properties. Under the new law an owner can build up his forest growing stock without fear of confiscatory taxation.

Fair taxation is a basic element of the favorable economic climate needed to encourage good management of New England's privately owned forests. New Hampshire has taken the lead. Maine shows signs of being on the way. Other states will doubtless benefit from their pioneering.

Government Loans

Press reports from Washington state that New Zealand's application for an Export-Import Bank Credit of up to $20,000,000 to finance part of the cost of an $85,000,000 lumber, pulp, and paper mill project has stirred up a significant controversy over the future course of Government's foreign lending operations. The Secretary of the Treasury in a recent statement to the advisory group on international trade of the Senate Banking Committee, stated that "the Government must question both its right and its financial ability to continue to use taxpayers' money to finance developments abroad on a large scale in the development of competitive enterprise," and that the Administration would try to limit assistance to foreign industries that do not compete with American producers.

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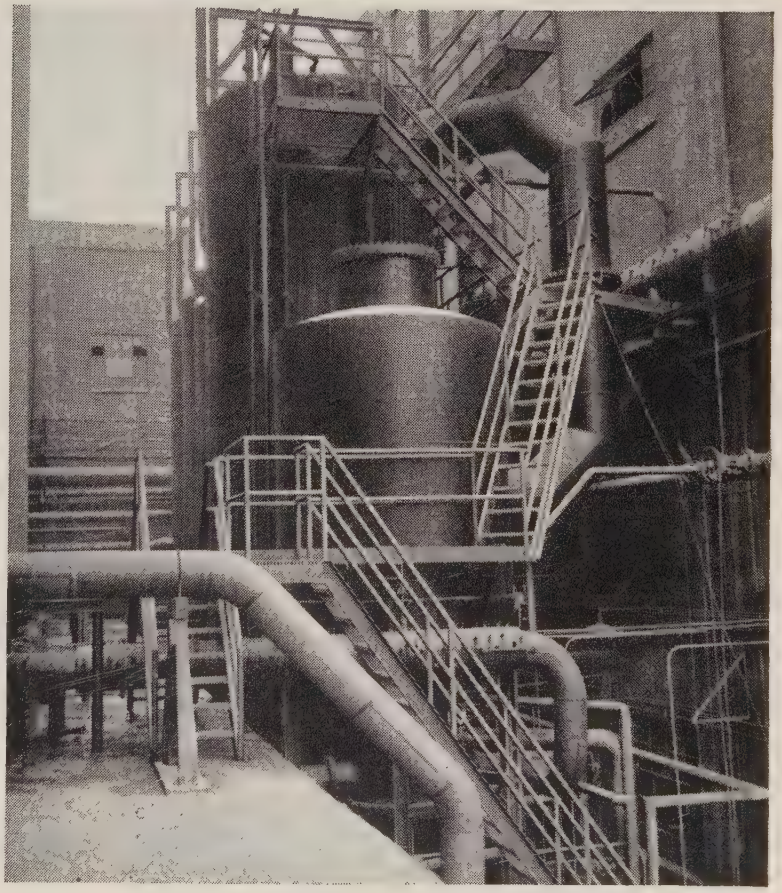

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Reforestation

The Dept. of Agriculture announced recently that for the first time in more than a decade private forest owners are replanting at a rate surpassing Federal reforestation. Since 1939, reforestation by private owners has aggregated 8,240,000 acres. Between 1939–41, reforestation was 51% by state and Federal agencies. In 1950–52, it was 79% by private owners. Georgia, Louisiana, Mississippi, and New York led in reforestation in 1952.

Venezuela

The Vollmer sugar and rum interests in Venezuela have announced that they will construct a paper mill using bagasse as a raw material, near San Mateo in the state of Aragua. The mill would be built in conjunction with the erection of a large new sugar refinery. The manufacture of paper from bagasse will be the first operation of its kind in Venezuela.

Chile

Press reports from Washington state that the International Bank for Reconstruction and Development granted a $20,000,000 loan to Chile on September 11 for the construction of a chemical pulp mill and a newsprint mill. The loan covers repayment in 17 years beginning May, 1958.

The pulp mill will produce about 50,000 tons of unbleached, semibleached, and bleached chemical pulp annually. Integrated with the pulp operations will be a paper mill designed to produce 10,000 tons of kraft paper per annum. The newsprint mill will have an annual capacity of 44,000 tons of newsprint and 6600 tons of boxboard. Raw materials will be mechanical pulp, chemical pulp, and wastepaper.

Finland

A new paper mill is planned for northern Finland to be integrated with the Veitsiluoto sulphite pulp mill. The plant will have an annual capcity of 30,000 tons of sulphite and sulphate wrappings and cartons and groundwood printing paper.

Norway

A record 37 million trees were planted in Norway during 1952, but the 1953 and 1954 plantings are scheduled at 43 million and 50 million trees, respectively. As an aid to the reforestation of the treeless districts in Western Norway, A/S Borregaard, one of the largest wood refining plants in Norway, has decided to grant loans totaling two million kroner. According to *Foreign Trade*, July 4, these loans are to run free of interest for 40 years and if repaid in timber, 25% of the original amount will be deducted.

Finland-Denmark

According to *The World's Paper Trade Review*, July 23, a trade agreement between Finland and Denmark valid until June 30, 1954, provides for exports from the former to the latter of 25,000 tons of cellulose, 7500 tons of wood pulp, and 30,000 tons of newsprint, other paper, and cardboard.

Brazil

Brazil plans to erect three large paper mills, according to an announcement by Licurgo Costa, director of the Brazilian Government Trade Bureau. The factories are intended to save Brazil about $5,000,000 yearly now spent on pulp imports and eventually cut sharply into the $30,000,000 the nation spends annually on newsprint imports.

The mills, as blueprinted by Brazil's Ministry of Agriculture and its Northern Agricultural Institute, would be geared for output of upward of 1000 tons each of wood pulp daily with a total yearly production of nearly 1,000,000 tons. No date for completion of the mills was reported, but in the United States it usually takes $1^1/_2$ years for a mill to be constructed and operating after ground is broken.

It was stated that foreign private capital is invited to participate in the venture. The mills would be located on the Island of Marajo at the mouth of the Amazon at a point of the river near the mouth of the Madiera, an Amazon tributary, and near Manaus, 1000 miles upstream on the Amazon.

Technical research on Amazon timber and mill processes leading up to the planning stage was carried out in France and the United States during the past 6 months. The processes to be used would make possible production of suitable pulp from selected tropical timbers little used for the purpose in the past.

Brazil already has several paper and pulp mills, although production is far below national requirements. The largest of them is the Klabin mills in the State of Parana, which turns out more than 60,000 tons yearly. (*Editor's Note:* Installed newsprint capacity of 44,000 short tons and 1952 output of 42,000 tons.)

It was understood that the government's first efforts will be to prepare the site. After that private capital would be invited. It is also understood that the mills will be erected with or without private aid.

N. Z. Forest Products

The first kraft pulp to be made from N. Z. grown pine trees was manufactured recently by N. Z. Forest Products Ltd. at their new Kinleith pulp and paper mills in the center of the North Island. Export of dried pulp lap to Australia has already commenced. N. Z. Forest Products Ltd. is now exporting over 1000 tons a month of kraft pulp to Australia to be used in the manufacture of newsprint. Capacity of the plant is 45,000 tons a year.

J. T. Christiansen (right) pulp and paper mill superintendent of Kinleith mills inspecting one of the first sheets of pulp, and H. Kilgour, the superintendent engineer, holding pine chips

Egypt

The Egyptian Government has invited firms specializing in paper production to submit offers for the establishment of a paper manufacturing plant in Egypt.

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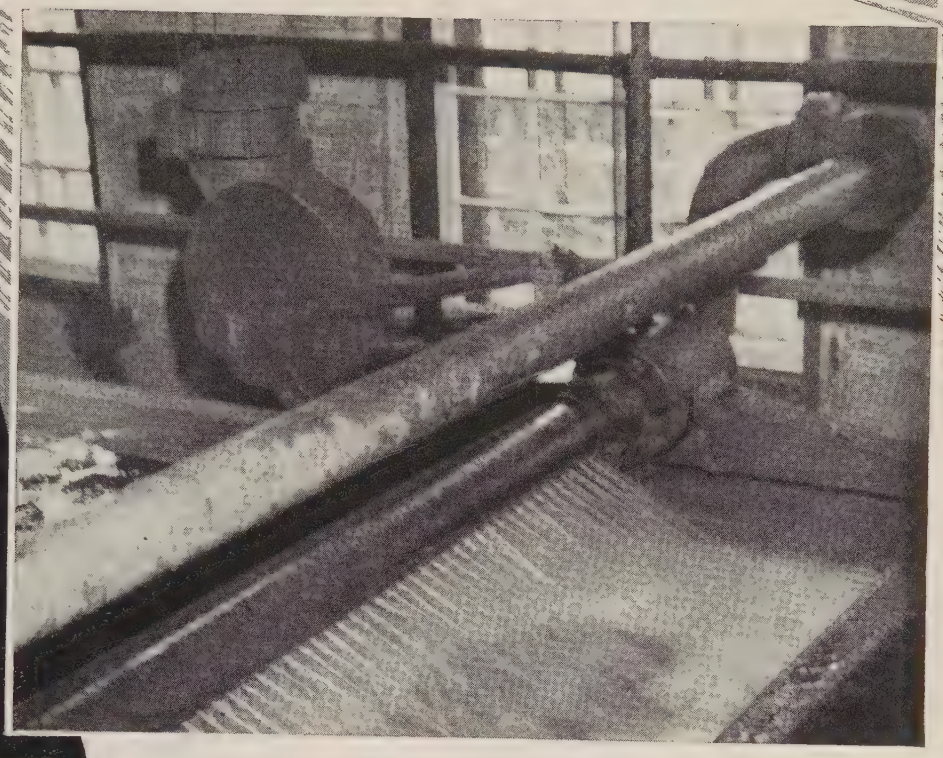


Fedralco Karlstrom Persson Water Distribution System for Flat Screens

NO CLOGGED PLATES

CLEANER SCREENING

LOWER COSTS

HIGHER PRODUCTION

ATTENTION BOARD MILL OPERATORS

At present in operation in several mills in Canada, the Karlstrom Persson Shower is proving to be one of the greatest innovations in the Pulp and Paper industry. Consisting of a perforated pipe extending the whole length of the screens, oscillated at a slow speed, the Karlstrom Persson Shower operates at very low water pressure and distributes water over the entire surface of screens, breaking up fibre bundles and separating them out for more complete screening.

Screening is free and complete. The plates are washed clean, leaving no matted fibre to dry and plug the slots during shut-downs and interruptions. They are ready to screen immediately.

Because of free and proper screening, high pressure hosing is eliminated. Dirt is not driven through the plates, nor is good fibre flushed out with the tailings.

With free screening, and little or no hosing required, labour costs are greatly reduced. The saving in labour alone can pay for this equipment in a comparatively short time.

Because plates are kept clean and screening continuously at maximum efficiency, greatly increased production is obtained.

References as to the success of present installations are available on request.

FEDRALCO

Manufactured in Canada by

UNION SCREEN PLATE CO. OF CANADA LIMITED

Sold and distributed by

THE FEDERAL MACHINERY & MANUFACTURING COMPANY LTD.

72 QUEEN STREET LENNOXVILLE, QUEBEC, CANADA

Raw materials available locally, such as rice straw and cotton stalks, are to be used in this plant, which should have a minimum capacity of 20,000 metric tons of printing and writing paper and 10,000 to 15,000 tons of newsprint. Design and layout are to provide for expansion of the plant, in the event increased local consumption warrants greater production. The plant must be operated by an Egyptian company which will be subject to the provisions of the Company Law as amended.

Tasman

Plant design and production plans have been completed by the Tasman Pulp and Paper Co., Auckland, N. Z., for a modern pulp, paper, and timber mill at Kamerau. Annual production in the first phase of operations is to be 75,000 tons of newsprint, 36,000 tons of pulp, and 72 million board feet of timber. Expansion of the plant at a later date is also planned, to bring the newsprint production up to 150,000 tons per year. C. B. Ashman, acting chairman of the Tasman Co., points out that these operations will complement, rather than compete with, those of Forest Products Ltd. and Whakatane Board Mills Ltd.

The company is expecting to sell at least 40,000 tons of newsprint annually in Australia, and 20,000 to 30,000 tons in New Zealand. Capital investment in the plant is estimated at $14,800,000.

Arkell and Smiths

Arkell and Smiths has just completed a $300,000 expansion program at their Wellsburg, W. Va., plant.

Eaton-Dikeman

T. J. Druding has been appointed sales manager of the Eaton-Dikeman Co., Mt. Holly Springs, Pa. Mr. Druding was formerly eastern district manager for Helena Rubinstein.

Monadnock

Monadnock Paper Co., Bennington, N. H., has contracted to use the Permachem process for treating its products to render them lethal to bacteria, fungi, and molds.

West Virginia

David L. Luke III has been elected vice-president of the West Virginia Pulp and Paper Co., New York, N. Y.

Powell River

Powell River Co., Powell River, N. C., has completed an experimental chemical pulping installation at its Central Laboratory in Powell River. Made entirely of stainless steel, the equipment is provided with automatic control instruments, and suitable for either acid or alkaline pulping experiments.

Town planning in the Powell River area is to be studied by the School of Architecture of the University of British Columbia, following a grant of $3500 to the school by the Powell River Co. Other Powell River grants to U.B.C. include $5000 for a chair of forestry and a $1000 annual grant for postgraduate work in paper chemistry.

Badger

Extending its lagooning operations for stream improvement, Badger Paper Mills, Peshtigo, Wis., is completing construction of a second lagoon to receive spent sulphite liquor not required for its roadbinder program. The company purchased for this purpose a sandy 100-acre tract on the Peshtigo River, two miles below its sulphite mill. On this land the company has built a lagoon 1000 ft. distant from the nearest point on the river, with a slope toward the river bank. Thus, liquor placed in this lagoon must filter through at least 1000 ft. of soil before reaching the stream.

Glatfelter

P. H. Glatfelter Co., Spring Grove, Pa., has started an improvement program that will cost approximately $3,800,000. Conversion of the company's soda mill to the sulphate process will involve the addition of a digester, a heat recovery system, a new liquor-making and causticizing system, and a C-E spray-type recovery boiler. A chlorine dioxide stage is to be added to the bleach plant, and the bleached stock storage system is to be modernized. Air pollution will be minimized by a Koppers precipitator on the recovery boiler, and the ClO_2 stage will improve the color of the bleach plant effluent.

Mead

On September 9, George H. Pringle, vice-president for white paper operations, Mead Corp., Chillicothe, Ohio, has assumed responsibility for the direction of Mead's Kingsport, Tenn. division in addition to his other duties. Mr. Pringle is president of TAPPI.

George F. McCrea, formerly Kingsport division manager, has been transferred to Chillicothe, where he will join the staff of first vice-president D. F. Morris.

St. Croix

St. Croix Paper Co., Woodland, Me., started up its new (no. 6) boiler on Sept. 14, 1953. Manufactured by the Riley Stoker Corp., the boiler is designed for a safe working pressure of 500 lb. but will operate at 475 lb. and deliver 175,000 lb. of steam per hr. This compares with 70,000 delivered by no. 6, and 110,000 lb. delivered by no. 3. Numbers 4 and 5 boilers deliver about 35,000 lb. each.

The furnace in no. 6 has a volume of 12,000 cu. ft., which is larger than many of the homes being built today. It is 84 ft. 5 in. from the basement floor to the top of the boiler and 96 ft. to the roof. Coal conveyors and distributors occupy the space between the boiler and the roof. The top drum is 27 ft. 6 in. long, 60 in. in diameter, with a wall $1^{27}/_{32}$ in. thick. The bottom drum is 24 ft. 6 in. long, 42 in. in diameter with wall thickness of $1^{11}/_{32}$ in. There are 107 tubes $3^1/_4$ in. in diameter and 564 tubes $2^1/_2$ in. in diameter. The heating surface of the boiler is 12,235 sq. ft., the water walls have 85,000 sq. ft., and the air heater has 38,500 sq. ft. The total weight of the boiler is 392 tons. The boiler holds 13,000 gal. of water, consuming 400 gal. per min. at 600 lb. pressure at a temperature of 210°F. It uses 213,000 lb. of air per hr. and this is preheated to a temperature of 600°F.

Coal from the bunkers is fed to the two pulverizers on the basement floor, each driven by a 200-hp. motor, and delivering coal to the feeders at a fineness of 90% through a 200-mesh screen. From the pulverizers the fuel passes to two feeders, each of which has a capacity of 12,000 lb. per hr. and feeds two burners on each side of the firebox. The forced draft fan is driven by a 125-hp. motor and can supply 260,000 lb. of air per hr. The induced draft fan is driven by a 200-hp. motor through a fluid drive, patterned after the drive on modern cars, and can exhaust 282,000 lb. of gases per hr.

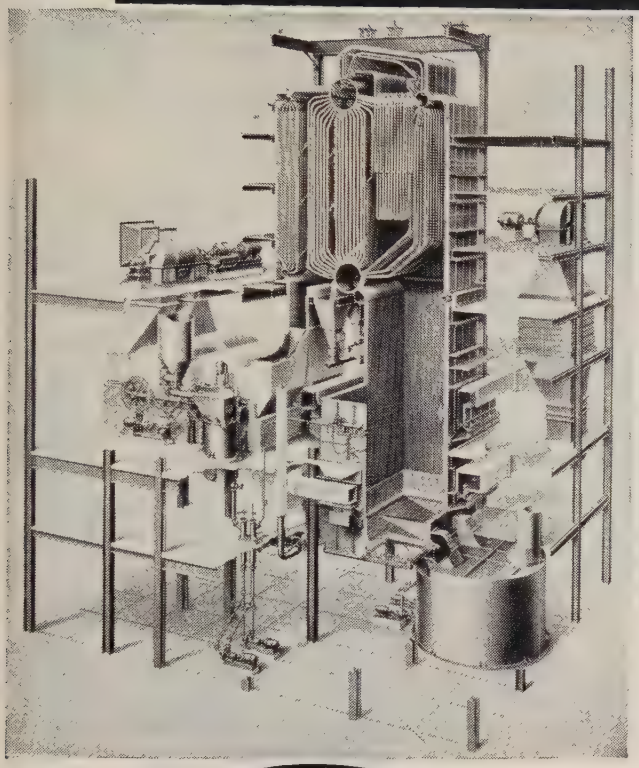
The control panel is shown in one of the accompanying pictures. It is a compact device for handling air, fuel, and water, and is in striking contrast to the old days of hand firing when a small army of men was necessary to handle coal and ashes. There is no ash handling with the new equipment as the slag is drawn off once daily through a slag tap.

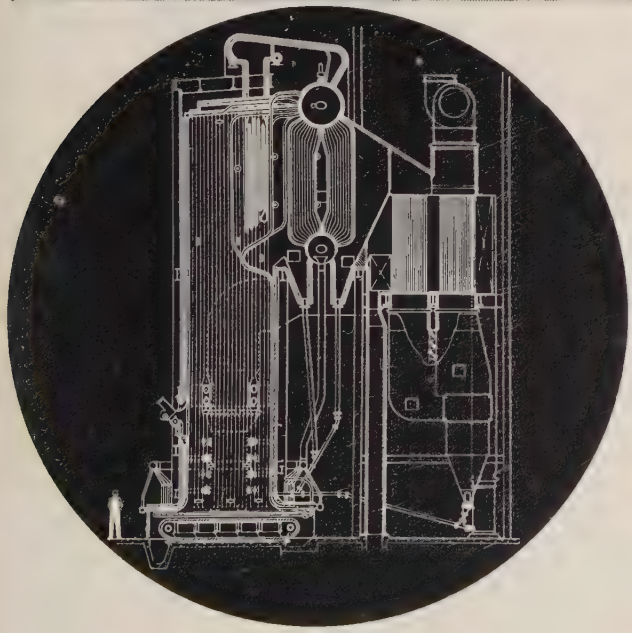
Number 6 will deliver 2500 additional kw. to the available power and will make a total of 12,500 kw. developed from steam, which accounts for all of the turbine capacity available at the present time. The ultimate in power production will not be reached until more generators are installed.

Although the boiler is designed for coal it will be possible to convert to oil at any time.

All of the construction work was carried out by the regular construction and repair crews with the exception of some of the piping which was handled by men from the Midwest Piping

this C-E equipment . . . at your service





C-E RECOVERY UNITS with an aggregate capacity of well over 50,000,000 lbs. of dry solids per 24 hours are now in service, under construction or on order. They vary in capacity up to 350 tons and for operating steam pressures up to 875 psi with temperatures to 825 F.

C-E Recovery Units are in service in many of the best known mills throughout the United States and Canada; other installations are in Europe and Latin America. Their repeat order record is exceptional. Three large companies have purchased C-E Recovery Units on four different occasions, two companies have ordered three times and eight companies have ordered twice. The reliability, efficiency and operating economy they anticipated from their first C-E Units became the reality upon which future orders were predicated.

C-E BARK BURNING UNITS bring to the pulp and paper industry a revolutionary bark burning method—proved in service—that will soon be paying impressive dividends to leading mills all over the country. The primary feature is turbulent-suspension burning. Bark or hogged wood is fed into the furnace by specially designed spreader units located at a considerable distance above grate level. Preheated air, introduced through nozzles at various furnace levels, assures extreme turbulence and, therefore, rapid and efficient combustion. Most of the bark burns in suspension — the balance burns quickly and evenly on the grate.

Reports from installations now in service show that overall savings have been very substantial, that performance has been excellent and that availability is exceptionally high.

OTHER C-E PRODUCTS for the pulp and paper industry include all types of boilers and fuel burning equipment and C-E Flash Drying Equipment which has been very successfully applied to existing lime burning operations to increase capacity and efficiency. B-643

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and Supply Co. All of the electrical work was handled by the electrical department without outside assistance. It is a tribute to the efficiency and safety-mindedness of all who work on the job that the work was completed without a single lost-time accident.

Mando

Minnesota and Ontario Paper Co. is producing a surface-sized, full bleached groundwood offset paper, known as Mando-set. Advantages claimed for the new sheet are: high bulking thickness, shorter drying time for printing inks, lower price. The sheet is said to be suitable for four-color printing.

Quarter Books

"There is real hope for a culture that makes it as easy to buy a book as it does a package of cigarettes." This observation was made by Eduard C. Lindeman, who has been a teacher at the New York School of Social Work, Columbia University, since 1924, and is a leader in adult education in the United States.

Mr. Lindeman was speaking of an item which is almost as familiar to us as our daily newspaper—the 25-cent pocket size book—which makes the classics as well as popular current fiction available to the reading public at extremely low cost.

The quarter book is so universally available, and has become so much a part of our reading habits, it is hard to realize that, in its present form, it is only a recent development in the book publishing field. In the short span of 13 years the pocket book industry has firmly established itself. Since 1939 over a billion copies have been sold and the annual volume is continually increasing. For instance, it is estimated that a total of about 270,000,000 of these books will be distributed in 1952, for which the public will pay approximately $66,600,000.

At first, paper-backed book publishing was concentrated on a wide distribution of titles which were mostly mysteries, westerns, and light novels. A few years ago the "whodunits" accounted for a little over half of the total books sold, but now they represent only 25%. This is not due to a lessening in the number of mysteries sold, but to a large increase in the publication and sale of other types of books. Today the novel is dominant in the field, representing approximately 48% of total sales.

Do inexpensive paper-bound books have an adverse effect on regular book sales? At first it was feared this might be so. However, except in rare cases they have not. In fact, trade book sales figures indicate that they have developed a new group of readers. For instance, the wholesale dollar volume of all book sales in 1951 was about equal to the record total reached in 1946. In the first 9 months of 1952 trade book sales were 12% higher than the first 9 months of 1951 and September, 1952, was 25% higher than September, 1951. These comparisons do not include book clubs, hard-cover reprints, paper-backed books, or juveniles priced under $1.00.

Fort Frances Mandonians have had a hand in shaping this revolution in reading habits. Paper-bound pocket books are not printed on expensive book papers or they could not be sold so cheaply. However, a good quality groundwood printing sheet is demanded by the publishers. Mando's Mirriprime, made in the Fort Frances mill, admirably fills the bill and is used by several pocket book publishers.

One of the largest users of our Fort Frances paper for this purpose is Bantam Books, Inc., with headquarters in New York. Approximately 20% of the paper they use is supplied from Fort Frances.

Bantam published its first list of 20 titles in January, 1946. These initial releases included books by Mark Twain, John Steinbeck, F. Scott Fitzgerald, Booth Tarkington, and Zane Grey, and established a new mark in publishing circles. In the beginning the monthly output was four titles. This was increased to six a month 2 years later. At present the schedule is nine titles, of which five titles are Bantams and four are Bantam Giants.

In February, 1950, Bantam Books initiated the 35-cent Giants. This came about because a method was needed for publishing popular long novels, which were not economical to produce for 25 cents. The solution was the Giants, which have twice or three times the reading material in the average quarter book. According to company officials, subsequent sales of the Giants have more than justified the risk involved. Some books were even too long to be produced economically in Giant size and necessitated another category. Thus the 50-cent size, known as the Bantam Fifty, appeared in 1951.

According to L. Newell Christiansen, director of production for Bantam, the firm's aim has always been to produce sound, worth-while books for distribution in the mass market. He also noted that it is an established policy to print every word that appears in the original copy. Books are not "cut" or "abridged," and the reader gets the complete story, as originally written by the author.

Kansas City Star

Sulphite pollution is a stubborn world-wide problem that nobody has completely solved anywhere as yet, and Wisconsin leads the world in work already done to clean up the streams, pulp and paper industry scientists and executives recently testified at a public hearing called at Appleton, Wis., by the State Committee on Water Pollution in response to a petition by residents downstream from this paper mill community. State scientists and engineers reported tests showing that the Flambeau River water is sometimes short of oxygen for several miles below the mill and that spent sulphite liquor from the mill is the principal cause of this condition.

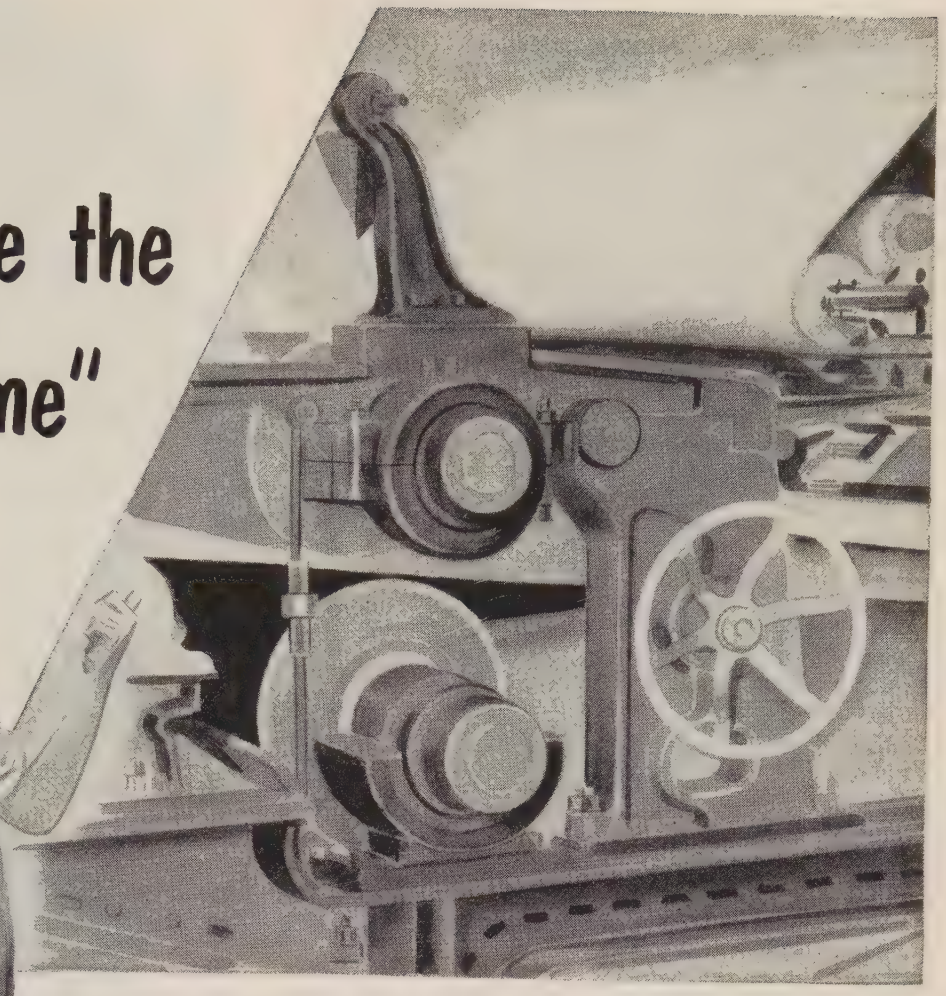
Steady efforts to improve river condition have been made by the mill ever since the Kansas City Star Co. bought it 6 years ago, Leonard Kuehl, general manager, told the State Committee and a hearing room full of local residents in his sworn statement. He cited clean-up of the mill's previous bark fiber, and sanitary discharges to the stream, and then detailed the mill's three-way program which he asserted has substantially increased the dissolved oxygen in the river water. Relying on a combination of forced-feed aeration of the stream below the mill, tripling the river's Summer-season flow by release of impounded waters from upstream, and an aggressive roadbinder program to keep millions of gallons of liquor out of the stream, Kuehl said the mill has already cut by several miles the downstream stretch of river in which oxygen deficiency would exist without these costly measures.

Jesse M. Holderby, vice-president of Lake States Yeas Corp. of Rhinelander and former research head of the Sulphite Pulp Manufacturers' Research League of Appleton, summarized for the hearing the progress to date in sulphite liquor technology achieved all over the world and declared Wisconsin mills are further along the road to an answer than any group elsewhere. They are going more to cut sulphite pollution than mills anywhere in the world, but have not yet found an answer that they can be sure is practicable for all mills. Several Wisconsin mills including his own company have in recent months completed plants to utilize spent sulphite liquor in nonpollutional ways and other plants are being built, but all of these must still be considered experimental and nobody can be sure they can carry their own weight until more experience has been developed, Holderby declared. He estimated that an evaporation and burning process might roll up an operating loss of several dollars a ton under adverse circumstances, and discussed his own firm's periodic difficulties in marketing at self-supporting prices torula yeast made from wood solids in spent sulphite liquor.

Kuehl testified his mill wants to rely upon intensifying its present pollution-reduction program until operating results of sulphite liquor treatment plants now in experimental use

HAM FELTZ says:

"Save the break-in time"



How many hours do you spend breaking in new felts for your board machines? Did it ever occur to you that you could save time by using felts that have been broken in and pre-shrunk before you use them? No necessity for you to keep adjusting stretch rolls to take up the slack that hangs down into the pit. Hamilton Felts do not sag—don't stretch, either.

Next time you are in the market for felts ask the Hamilton Sales Engineer why Hamilton Felts remove water faster, require less time for adjustment—why Hamiltons put finer finish on your sheet and why they last so much *longer* without getting *shorter*.

Hamilton Felts

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SHULER & BENNINGHOFEN, HAMILTON, OHIO

in Wisconsin show whether the Flambeau Paper Mill could support the cost of these processes and still remain in business.

Southern Advance

Before a crowd of 350 persons gathered at the Southern Advance Bag & Paper Co. pine tree nursery near Jonesboro, the Louisiana Forestry Assn. presented Tree Farm certificates to 16 North Louisiana landowners for following good forestry practices on their lands. The Tree Farms dedicated at the ceremony totaled 108,278 acres. This brings the state's certified acreage to 1,577,200 in 101 units.

Canada Paper

Canada dedicated a 35,000-acre industrial Tree Farm at Windsor Mills, Que., this Summer. The Tree Farm, owned by Canada Paper Co., produces from three to four times the wood per acre grown on surrounding land which is not managed in accordance with Tree Farm standards. The firm will aid landowners within a 65-mile radius to increase tree growth.

Charmin

Cows may someday be eating sawdust.

Many animals, including the cow, can digest cellulose, but they can't digest wood because of lignin and other unknown factors. Scientists recently have found that, by means of electron irradiation, wood can be converted into a form which can be digested in a cow's stomach.

Experiments in electron irradiation are being carried on at the general research laboratory of the General Electric Co. near Schenectady, N. Y. A number of agricultural experiment stations and the U. S. Forest Products Laboratory are interested in the studies and are conducting tests of their own on the treating of sawdust to make it a readily digested cattle food.

Meanwhile, specialists at the University of Wisconsin are experimenting with pulp waste as a possible source of poultry feed.

A product, called torula yeast, can be produced from the liquid drawn off after wood pulp is treated with sulphite. The yeast contains about 45% protein and some valuable vitamins and unidentified factors.

Torula yeast, unlike the more familiar active yeasts used in baking and brewing, is not a leavening agent but an inactive yeast of purely nutritional value. During World War II, Germany, the Scandinavian and other European countries, cut off from Western Hemisphere meat supplies, produced torula in plants built and operated during the emergency by their pulp and paper industries and used it to supplement the vitamin and protein requirements in their national diets.

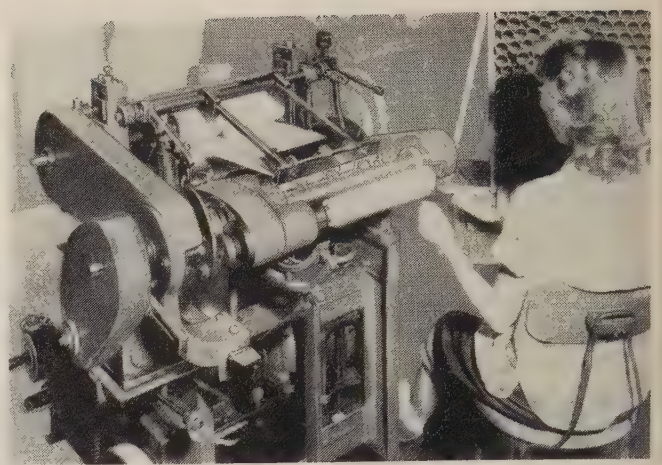
Wisconsin pulp and paper industries also were experimenting in the production of the new yeast and in 1948 put up an experimental plant with an annual production of almost 3,000,000 lb. The plant is still operating.

Now the Charmin Paper Mills, formerly Hoberg Paper Mills, is constructing a new torula yeast producing plant adjacent to their mills at Green Bay, which will have an annual production capacity of at least 10,000,000 lb. Cooperating with the paper company is the Red Star Yeast & Products Co. which is beginning research in torula yeast to develop additional new uses and a full line of products.

The two companies look to further establishing of torula yeast as an ingredient in human foods, animal feed, and as a basic material for pharmaceuticals. The yeast is derived in a continuous process from tree sugars extracted from wood solids otherwise unused in pulp and paper manufacturing.

Crystal Waxing

A new machine for continuously winding small diameter rolls has been developed by The Crystal Waxing Co., a subsidiary of The Crystal Tissue Co., of Middletown, Ohio. A battery of these new winders have been in production on Household Waxed Paper for the past 10 years.



The new continuous winder for small diameter rolls which was developed by The Crystal Waxing Co.

Patent coverage has been allowed for this new machine which is to be made available to paper converters by The Black-Clawson Co. through its Dilts Machine Works Div. at Fulton, N. Y.

The accompanying photograph shows the winder in operation winding $2^1/_4$-in. diameter rolls of 12-in. width waxed paper at 1000 f.p.m.

Rayonier

New Dissolving pulp

A new and improved type of cellulose has been developed especially for use in high stretch rayon spinning techniques. This product coupled with the new spinning techniques holds strong promises for revitalizing and expanding the manufacture and use of rayon yarn and staple for tire cord, fabrics, and wide textile applications.

High-tenacity rayon yarn for tire cord with strengths superior to those in current use, and staple fiber and yarn for viscose rayon fabrics with characteristics far surpassing those of today are now possible with the new cellulose announced by Rayonier, Inc., New York, N. Y., chemical cellulose producer.

The new product, Rayocord-X, is said to be one of the major single achievements since wood became the chief source of cellulose some 25 years ago. The new cellulose, according to Rayonier, holds highest hopes not only for tire cord production but importantly for the rayon industry, as fabric produced from this newly developed fiber will possess tenacity and washability superior to those currently manufactured.

Resulting from nearly a quarter century of continuing research, Rayocord-X is described as a high alpha-cellulose made by the sulphite process, a cellulose composed of chains of uniform length such that, in high stretch viscose spinning, the chains may be formed in a highly ordered pattern. This imparts high strength, resistance, and toughness to the filaments thus regenerated from solution. Theoretical calculations have predicted such high strengths through orientation and, in fact, strengths far beyond these, but commercial realization has only recently appeared possible.

Arthur N. Parrett, Rayonier's vice-president in charge of research, said that the new sulphite cellulose, when employed with new spinning techniques in the manufacture of rayon yarn for textiles and high tenacity tire cord, will result in products possessing high fatigue life, high strength, toughness, and resistance to laundering.

Mr. Parrett observed that to the layman it might not appear impressive that tire cord strengths can be increased to over 3 grams per denier after the twisting of yarns into cord. But the added strength is "indeed impressive," one that was made possible by the unusual physical structure of cellulose mole-

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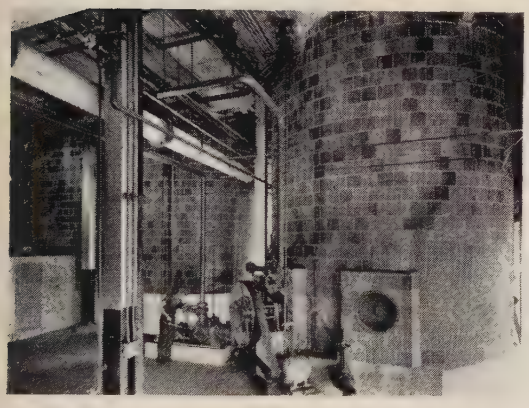

Complete service — design, engineering, construction, maintenance — of corrosion-resistant storage and process structures — from the smallest to the largest.

For wet materials, these structures are reinforced concrete faced on both sides with glazed tile; for dry materials, they can be either this same construction or steel-reinforced hollow tile.

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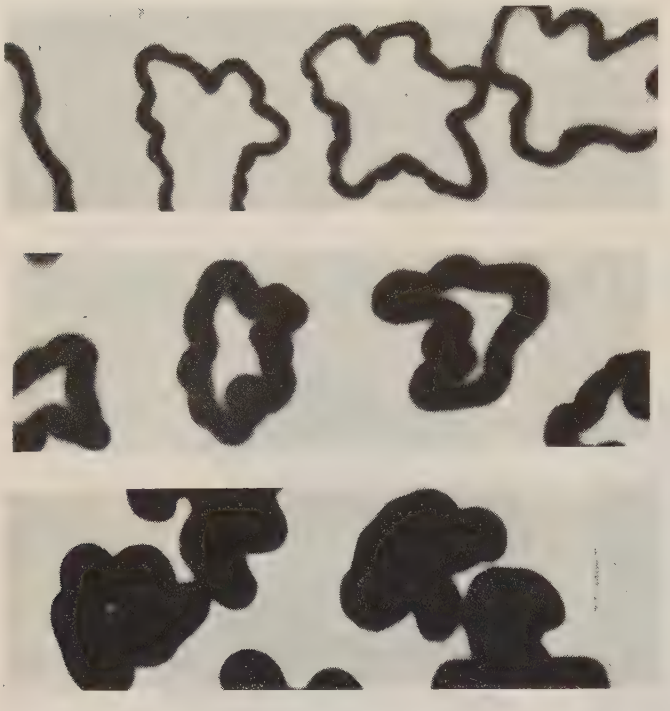

Picture at the top shows a 2200 times magnification of thin-skin conventional textile rayon. In the middle is pictured medium-skin conventional tire cord, also magnified 2200 times. The bottom 2200 × magnification represents the new, all-skin high-stretch process tire cord manufactured from Rayonier's new chemical cellulose, Rayocord-X

Note: *In preparing these filament sections a very thin cross section is cut from a bundle of paraffin-embedded filaments and sealed to a microscope slide. The skin is rendered visible by a cross dyeing and leaching technique which results in differential staining of the skin and core using Calcomine Brilliant Yellow and Victoria Blue dyes A photograph is then taken through a high-power microscope*

cules leading to uniform distribution and paralleled orientation in high stretch spinning processes.

It was explained that this new cellulose makes it possible to stretch the filament 100% and more during the spinning process. Conventional rayon fibers during the spinning phase are normally stretched only 30% for textile yarns and up to 60% for tire cord yarns. He added that Rayonier has demonstrated such results in its own rayon pilot plant by using high stretch spinning techniques.

The high stretch process permits drawing cellulose chains into a highly oriented, crystalline structure throughout the entire filament cross section. Conventional rayons of today have this effect only as an outer skin of the filaments, the core being unoriented, amorphous cellulose lacking in strength and durability. It is impractical to apply extreme stretch using a viscose prepared from cellulose of uneven polymolecularity.

Tests conducted by the Rayonier Research Div. are said to reveal that tire cords manufactured from Rayocord-X by high stretch spinning techniques have proved fully competitive in quality with cords produced from blends of cotton linters and other wood cellulose types. The new Rayonier fiber is considered by the company to be a complete and more economical replacement of these blended cellulosics.

Tires built of cord produced from Rayocord-X should possess greater resistance to fatigue and shock because of the advantage gained from the use of this new basic raw material in advanced spinning techniques.

Laboratory tests have convinced Rayonier researchers that the new fiber possesses cellulose qualities superior to any other product commercially available, and that Rayonier's sulphite facilities are sufficiently large to produce quantities commensurate with industrial needs both here and abroad. It was noted that the company's new mill, curently in construction at Jesup, Ga., will also produce a high quality cellulose especially suitable for the new developments in tire cord, rayon, and staple fiber.

The importance of Rayocord-X for rayon fabrics was noted by the fact that untwisted rayon yarns and staple fiber, made from the new cellulose by high-stretch spinning processes, possess strengths up to 4 grams per denier.

Not only do these new rayon yarns have higher strength and better wearing qualities, but they will withstand laundering, say the Rayonier research scientists.

Conventional rayon fibers have strengths of approximately 2 grams per denier. Their filaments are usually nonuniform and possess weak inner cores. But, according to Rayonier, fibers made from the new cellulose together with the new spinning techniques will swell less when wet. Textile rayons currently manufactured expand 150% when wet, while new ones which can be made from Rayocord-X swell only 65 to 75%.

Rayons made from Rayonier's new cellulose will possess the essential quality of moisture transmission which is so important for human comfort. And the fact that these new rayons will immediately lend themselves to ordinary laundering practices insures for rayon a continuing high position among all types of yarns and fabrics.

In the end, says Rayonier, the ultimate consumer is the one most to benefit from this new development because rayon and staple fibers are inherently cheaper to produce than many other man-made fibers.

Mr. Parrett pointed out that cellulose from trees, the basic raw material not only for rayon and tire cord, but for acetate, cellophane, film, lacquers, and a host of useful products, is readily and cheaply available. "It is a replenishable raw material and its benefits to man, while numerous, will undoubtedly be increased as research and development continue and more people throughout the world come to use more cellulose as living standards and quality standards rise."

Calculations, previously mentioned, have indicated that strength characteristics far above anything yet achieved are theoretically possible in regenerated cellulose filaments. These calculations range as high as 15 grams per denier, a degree of strength almost unknown in any type of material. With such an ultimate goal in sight Rayonier's job is to develop and be ready to supply new forms of cellulose for new products and new requirements.

Rayonier Plantings

To insure a steady supply of wood to maintain future chemical cellulose production schedules at a high level, Rayonier, Inc., put its mechanical seedling planters to work for farmers and small landowners in Florida and Southern Georgia during the 1952–53 planting season.

According to Stuart Davis, in charge of this cellulose producer's land management activities, over 650,000 trees were planted on approximately 1000 acres belonging to private holders, while the company planted more than 2,200,000 slash pine seedlings in its southeast woodland reserves.

Three company-owned planters were used by 29 landowners from November through March, the normal tree planting season in this section. The plantings ran through an area of more than 300 miles, from Central Florida to Southern Georgia.

Harmac

Expansion of the 250-ton Harmac Mill of MacMillan & Bloedel Ltd. to a daily capacity of 600 tons of high quality bleached pulp began in 1951 and was completed in October, 1953.

Since the inception of Harmac Mill, sales have been in the hands of Price & Pierce, Ltd., who are Harmac's exclusive selling agents, not only in the United States but in all world markets.

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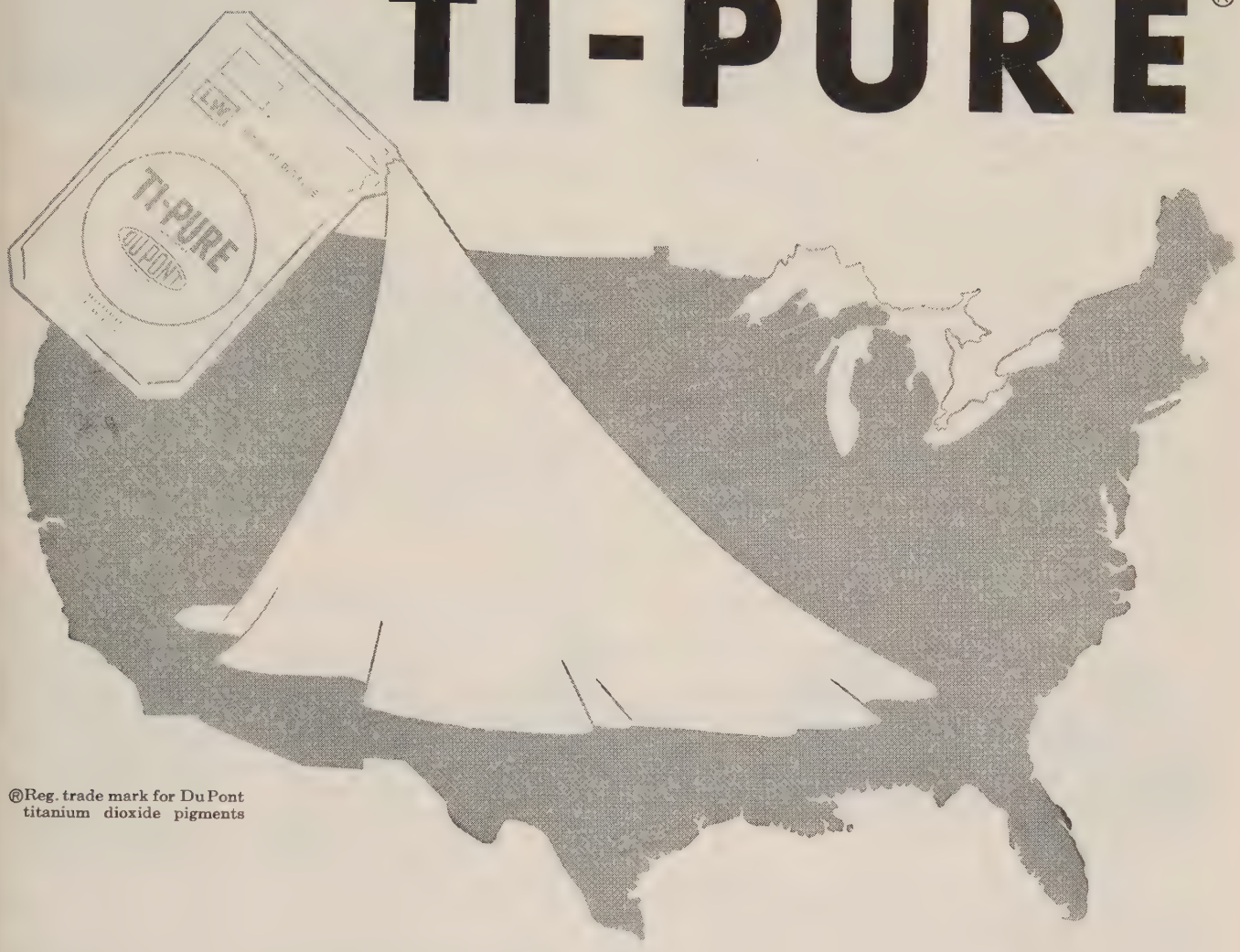

®Reg. trade mark for Du Pont titanium dioxide pigments

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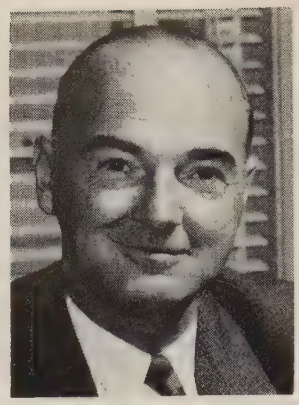
B. M. Hoffmeister, President, MacMillan & Bloedel Ltd.



C. Crispin, Vice-President, Pulp Dept., MacMillan & Bloedel Ltd.

View looking East, showing chip storage silos, miscellaneous shops, and material storage

The design and supervision of construction were placed in charge of H. A. Simons Ltd. of Vancouver, who built the original mill and two other mills on Vancouver Island. The purchasing and expediting of materials and equipment, cost control, warehousing, and accounting for the entire job were the responsibility of this outstanding firm.

The major contractor was Dominion Construction, Ltd., who supplied labor and supervision for the construction of foundations and buildings and certain machinery installations. Dominion Bridge Co. Ltd. was responsible for the steel erection of certain tanks, the digesters, and the recovery and new steam boiler buildings Other contractors include: Vancouver Pipe, Pacific Steel Erectors, Rust Engineering, Combustion Engineering.

Deep-Sea Wharf

In October, 1952, the new deep-sea wharf, built to berth ocean-going freighters, was completed. Due to the solid rock bottom and strong tidal currents which prevented the use of fill, the wharf had to be built on concrete piers. Sixteen piers were poured, which were finally topped with a steel and concrete deck. This new wharf will allow one deep-sea vessel to berth on the seaward side and smaller coastwise ships or scows on the shoreward side.

Chip Handling

Previously reported was the addition of three chip storage silos, bringing the total number of silos to ten, capable of holding approximately 3750 units of chips.

Also reported earlier was the installation to handle chips brought in to the mill by truck from sawmills on the Island not on tidewater. Ten-unit trailers are dumped and the chips are blown up into the silos by a "Conveyair" pneumatic system.

Except for an alteration to the barker log conveyors, the woodroom remains unchanged. With the start-up of the new mill it is expected that a substantial portion of chips will be supplied from whole logs, unsuitable for lumber manufacture, barked and chipped in the woodroom.

Tne chip screen building has been enlarged so as to allow for the installation of another four Rotex chip screens and surge bins.

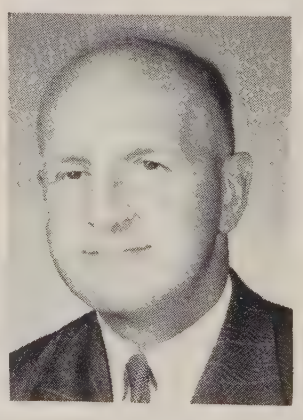
Digesters

The mill added eight new 11-ft. 6-in. diam., 54-ft. 11-in. high digesters (two Inconel lined A. O. Smith digesters spot-welded by John Inglis Co. and six carbon steel digesters built by Dominion Bridge Co.) to bring the total in the mill to twelve. Four of the new digesters, with their heating systems are housed in a separate building. The main digester building now has eight digesters. All the digesters are 4700 cu. ft. capacity. The circulation system was supplied by ESCO and is stainless steel throughout. The new digesters are equipped with Yarnall-Waring motor-operated blow valves.

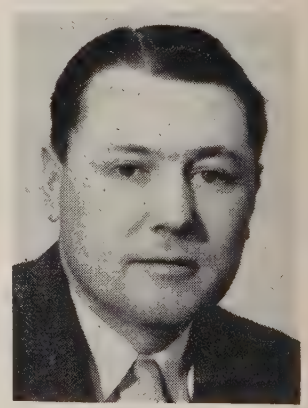
Although the digester capacity has been increased 300%, production will only be doubled. This excess in digester capacity will provide greater cooking flexibility, enabling the mill to produce a pulp of even greater uniformity and higher quality.

Also added is a second Dominion Bridge blow tank of 26 ft. diam. by 21-ft. 6-in. cylindrical center section, and a bottom cone of 21-ft. 4-in. Three special heat exchangers (Rosen-

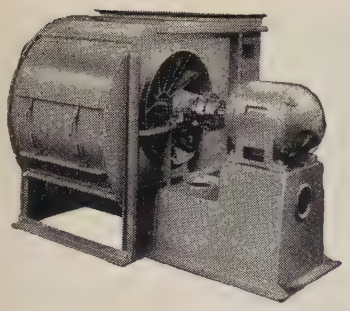
View looking North-East, showing deep-sea wharf, chip and hog fuel unloading crane



C. W. E. Locke, General Manager, Harmac Pulp Div.



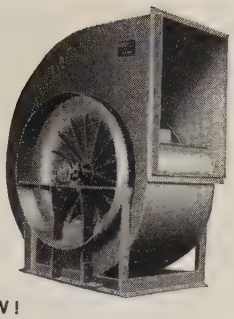
L. G. Harris, Manager, Harmac Pulp Div.



DRAFT FANS

"Buffalo" mechanical Draft Fans are helping turn out low-cost steam in plants and major utility stations everywhere.

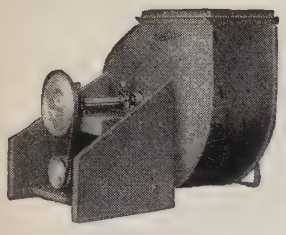
BULLETIN 3750



NEW!
TYPE "BL" FANS

In sizes for 1,000 to 500,000 cfm, these new non-overloading fans for general ventilation and air conditioning offer even finer performance than their famous predecessors, the "LL" Fans.

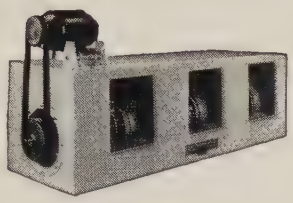
NEW BULLETIN F-100



BELTED VENT SETS

Non-overloading ventilating fans for duct or free air delivery. Extra quiet.

BULLETIN 3720



SHORTBOY VENTILATING SETS

Quiet, efficient, vibration-free fans. Wheels mounted on hollow shaft.

BULLETIN 3701

THE FAN for your JOB IS ON THIS PAGE

"Buffalo" Fans give "extras" in performance for two reasons: First, the line is so complete that you can pick — with mathematical accuracy — the fan to give you best possible results on almost any air moving job you could name. Second is the "Q" Factor, or inbuilt quality that "Buffalo" engineers have always insisted on. Why not have us mail you Bulletins on the right fans for your air job — from the complete line shown here?

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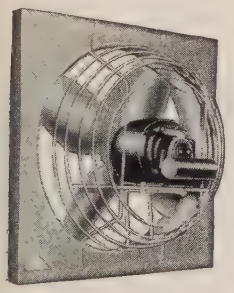
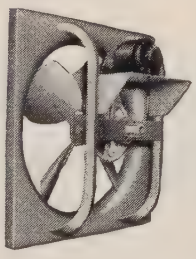


New! NV-BREEZO FANS

Their specially-shaped four-blade wheel gives high efficiency even against system pressures of ¼" and ½". 8" to 24" sizes.

BULLETIN 3865



New! BELT-AIR FANS

Quiet, sturdy fans to move a lot of air at negligible cost. Heavy-gauge die-stamped blades and panel.

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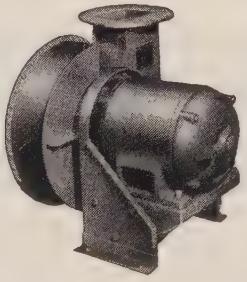
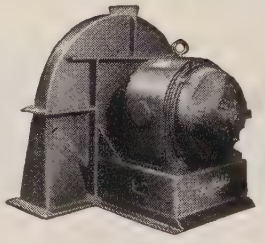


"CB" PRESSURE BLOWERS

Up to 2¼ psi, single stage with these husky, space-saving units!

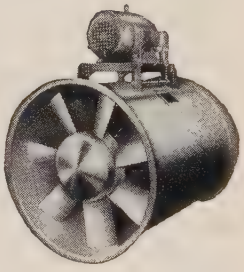
BULLETIN 3553



"CC" PRESSURE BLOWERS

In sizes for up to 4 psi, and capacities up to 75,000 cfm. Complete range of sizes, extra heavy-duty construction.

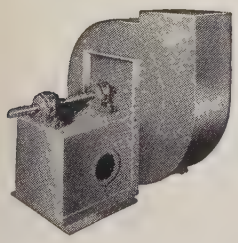
BULLETIN 3553



AXIAL FLOW FANS

Compact, light, highly efficient ventilating fans for light duty.

BULLETIN 3533



INDUSTRIAL EXHAUSTERS

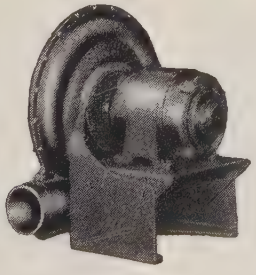
All-welded for strength and high efficiency. With air or material wheels.

BULLETIN 3576

"RE" BLOWERS - EXHAUSTERS

For pressures up to 40" of water; 50 to 1600 cfm. Furnace blowing, line boosting.

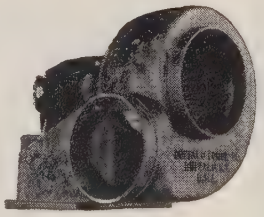
BULLETIN 3014



"E" BLOWERS - EXHAUSTERS

For low to medium pressures and volumes in draft, cleaning, line boosting.

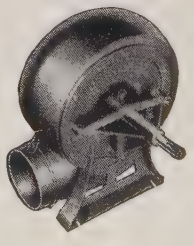
BULLETIN 3014



BABY CONOIDAL FANS

Adjustable discharge, compact design, multi-blade rotors make these fans ideal for many small jobs.

BULLETIN 3576



VOLUME FANS

Rugged blowers-exhausters with cast iron housings and dust-proof ball bearings for any job up to 10" s.p.

BULLETIN 3615

General view looking East, showing warehouse, machine room, bleach plants, main office, and recovery buildings

blad) have been added to the original two heat exchangers of the digester heat recovery system. A second jet condenser to condense the digester blow gases from the new blow tank has been added.

In order to recover the heat from the digester relief gases a small jet condenser has been added, the condensate going to the existing accumulator tank of the heat recovery system.

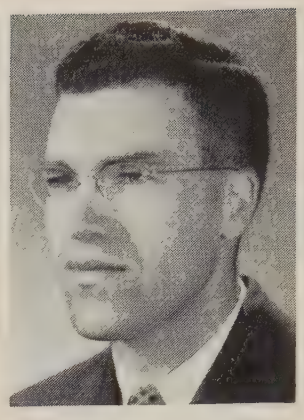
Brown stock washing was increased by adding the line of three $11^1/_2$ by 16-ft. Sherbrooke brown stock washers, preceded by four Johnson knotters, with a second Gruendler knot crusher and knot storage tank. Instrumentation was by Minneapolis-Honeywell. Three separate filtrate seal tanks, a foam tank, and two storage tanks were supplied by the Dominion Bridge Co.

The brown stock washers are larger both in capacity and physical size than the washers used in the original mill. The extra capacity in these new washers ensures efficient recovery of black liquor and a well-washed pulp.

The circulation of the filtrate is conventional, with the recovered liquor going to the weak black liquor storage tanks.

Three Kamyr-type high-density towers have been added to take the high-density stock from the washers.

In the enlarged screen room eight lines of Waterous flat screens were added to the existing twelve lines which formerly screened the brown stock and bleached stock (eight brown stock, four bleached stock). The old installation of twelve lines will now handle the brown stock, which is then thickened by five Sherbrooke deckers. The new set of eight lines will screen the bleached pulp followed by thickening by four Sherbrooke deckers. Two decker stock chests and white water chests have been added to the original four stock chests and two white water chests. Tile lining of these chests was by Stebbins Engineering & Manufacturing Co.



J. S. Rogers, Plant Engineer, Harmac Pulp Div.

Bleach Plant

A new bleach plant has been built, duplicating the first 8-stage bleach plant. The towers, lined by Stebbins Engineering, have a larger capacity than the towers in the first plant. Sherbrooke Machineries supplied the eight 11-ft. 6-in. by 14-ft. washers, three of which are rubber lined. As in the original bleach plant, caustic soda, chlorine, chlorine dioxide, and calcium hypochlorite are the bleaching chemicals used.

The bleached stock is discharged into the two high-density storage tanks of Kamyr design.

The bleached pulp is rescreened, as described previously, in order to remove dirt, shives, fiber bundles, etc. The stock then passes over the bleach deckers, thence to the decker stock chests and a second pulp machine blending tank

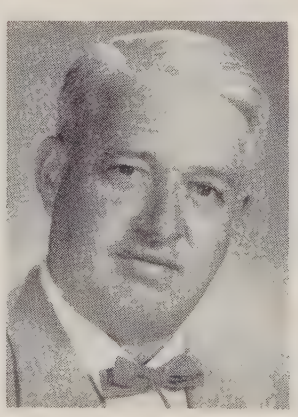
All stock and water lines from the unbleached high-density towers to the pulp machine are of wood stave or stainless steel construction, so as to ensure no contamination of the stock. The twin bleaching plants and auxiliaries are thus equipped to produce high brightness chlorine dioxide bleached pulp, making Harmac one of the world's largest producers of first quality, clean, high white papermaking grades of sulphate market pulp.

Machine Room

The existing machine room was extended to the North allowing for a second machine and auxiliary equipment to be installed.

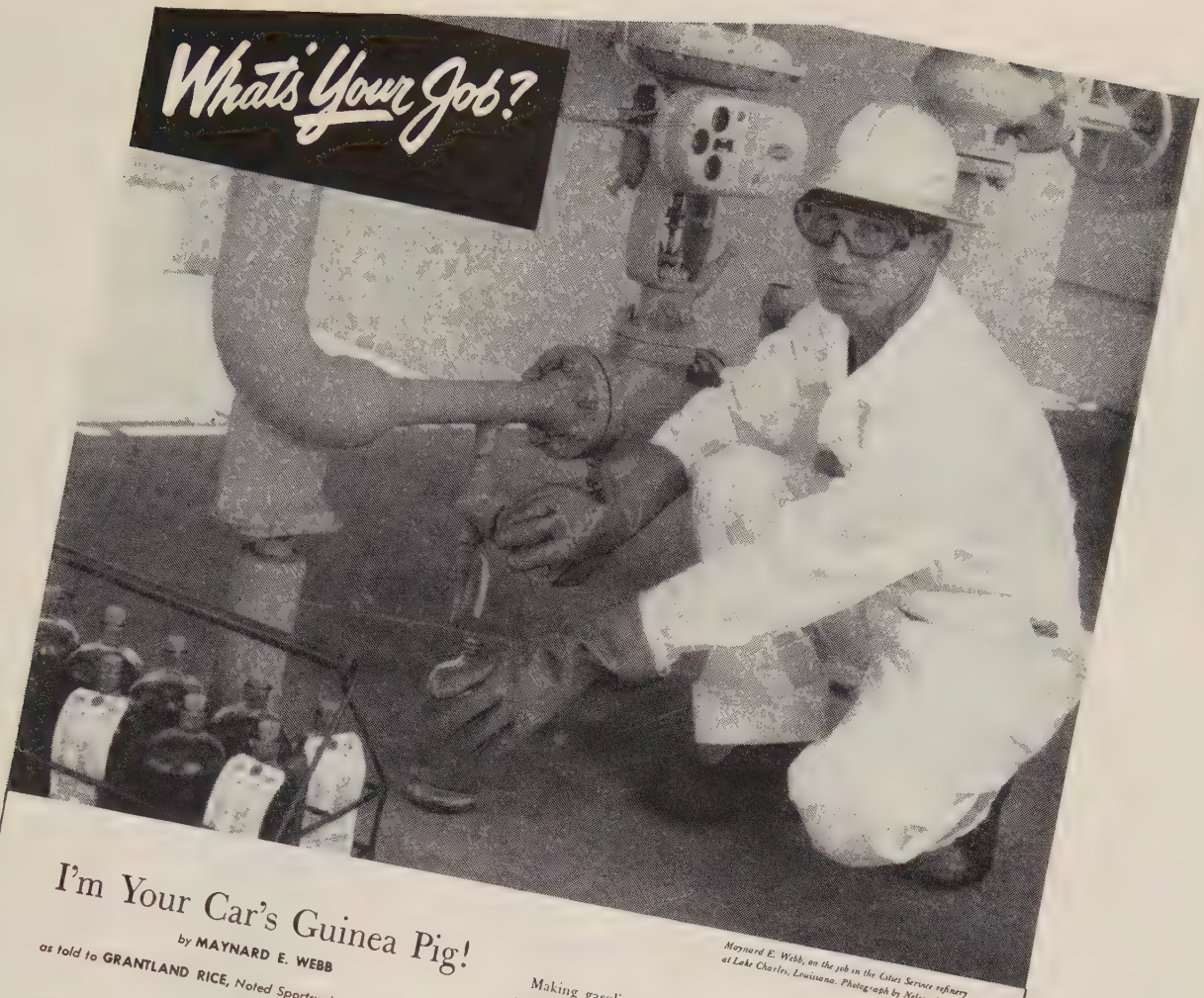
The Dominion Engineering fourdrinier section of the new machine uses a wire 178 in. wide and 80 ft. long, has thirty 7-in. diam. table rolls, six oscillating suction boxes, Nash automatic wire guide, and Lodding-type doctors. The suction couch roll is 36 in. in diam. and is fitted with a double suction box.

D. H. Baker, Asst. to Manager, Harmac Pulp Div.



E. Walloe, Superintendent, Harmac Pulp Div.

General view, looking South-East, showing causticizing room, line kilns, and recovery plants



Maynard E. Webb, on the job in the Cities Service refinery at Lake Charles, Louisiana. Photograph by Nelson Morris.

I'm Your Car's Guinea Pig!

by MAYNARD E. WEBB

as told to GRANTLAND RICE, Noted Sportswriter and Commentator

THEY TRY OUT the gasoline ... If our reaction ...

Making gasoline is a lot like making baby food, at ... compression engine is as sensitive to ... formula. When a baby ... "someth...

... every 15 minutes, test up to 20 different ways, and report our findings.

We couldn't be fussier if we were making baby food.

... course, is over-simplifying the care we take to turn out a fine gasoline. A book could be written on the subject. But I think you'll agree that we guinea pigs are probably the most important people in this refinery—from your car's point of view, that is.

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Masoneilan 10000 Series Valve and 7000 Series Positioner at work in Cities Service refinery at Lake Charles, Louisiana

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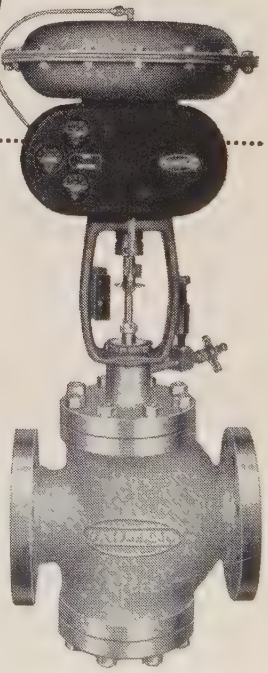

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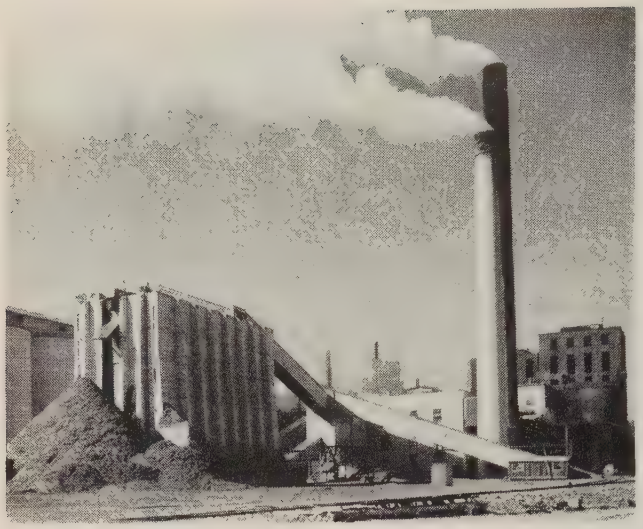

View looking South-West, showing hog fuel storage, conveyor structures, smoke stacks, and back of recovery and hog fuel boiler buildings

Three Bingham 125-hp. vacuum pumps provide the vacuum for the machine.

A new overhead crane supplied by Provincial Engineering extends across both machines and replaces the old crane which serviced no. 1 machine.

The press section of the new machine includes three sets of 36-in. diam. rubber-covered bottom press rolls and 30-in. diam. top rolls. Pneumatic cylinders are provided for top roll pressure or lifting. The air pressure on the cylinders is recorded and regulated by instruments mounted on panels convenient to the operators. The sheet passes through the first two press sections and then over two 60-in. diam. predriers designed to increase water removal in the third press. Finally the sheet passes through the third press and into the drier.

Each press is equipped with a suction box and a shower pipe to clean the felts. All doctors are Lodding type, the top press roll doctors being oscillated.

All rolls in the fourdrinier and press section are balanced for a surface speed of 250 f.p.m. All felt rolls are rubber covered and all bearings are antifriction.

The sheets pass from the third press over a Toledo Scale automatic basis weight controller and then into a conventional "Flakt" drier. The horizontal type drier built by Svenska Flaktfabriken in Sweden is 15 decks high compared to the no. 1 machine drier of 13 decks. Six fans on either side of the drier provide the forced air circulation.

Paper Machinery Ltd. supplied the new "Flakt" ventilation system for the entire machine room building, as well as the new "Flakt" heat recovery system for both machines.

The dry sheet leaving the drier is then passed to a heavy duty cutter and automatic layboy supplied by Lamb-Grays Harbor Co. The stacked sheets are conveyed to a second 800-ton Baldwin press equipped with an oversize pump, giving high ram speed and long dwell periods.

The new machine is driven by a Harland sectional drive with individually controlled motors for each section of the machine. The motors are interlocked by the Harland system of differential control.

Pulp Storage

The existing pulp warehouse was extended, providing a total warehouse storage capacity of 10,000 tons. This building is constructed entirely of wood with the exception of the footings and a concrete loading platform.

Steam, Recovery, and Causticizing

Additional evaporator capacity was installed using sextuple effect Swenson evaporators. The new evaporators have a design capacity of 600 g.p.m. of weak black liquor (17% solids). These evaporators are of greater capacity than the original sextuple effect installation and have integral catchalls instead of separate centrifugal type catchalls which are used in the first unit.

The concentrated liquor from the evaporators is further concentrated in a new Murray cascade evaporator, which is larger than the first installation. The new cascade evaporator uses tubes rather than flat plates which are used in the original evaporator.

The new Combustion Engineering recovery furnace is a spray type with a design pressure of 675 p.s.i.; it has a heating surface of 37,930 sq. ft. and is designed to handle 1,020,000 lb. of dry solids per 24 hr., with a steam capacity of 175,000 lb. per hr. Larger than the no. 1 recovery furnace, there are certain differences between the two units. The new unit has a water-cooled bottom and has been supplied with a C.E. Elesco superheater. The chemical ash system is continuous, utilizing strong black liquor instead of the circulating weak black liquor, the method used in the first unit.

A Diamond automatic sequential air control system is used together with Diamond long and short retracting types soot blower installation.

Two new 350-lb. air compressors supplied by the John Inglis Co. provide additional air for the soot blowing system.

The new deaerating heater is a Cochrane atomizing type. The ID and FD fans were supplied by Canadian Sirocco Co., who also supplied the air heater and hydraulic coupling for the turbine-driven ID fan.

The new Combustion Engineering VU hog fuel boiler which provides additional process steam to the mill has a spreader stoker type of firing rather than the Dutch oven type used in the first two installations. This new boiler produces 120,000 lb. of steam per hr. As in the first two units, steam-atomized oil burners have been installed as an alternative means of firing.

Feedwater is conditioned by the Alchem system and is pumped by two Bingham pumps, one turbine driven and one motor driven. Boiler controls and instruments are by Bailey.

A second electrostatic precipitator has been built adjacent to the first precipitator. The recovery furnace gases from both precipitators pass into the original stack. A second stack has been built to carry off the gases from the three hog fuel boilers.

A second Dorr continuous causticizing system of a larger capacity than the first unit has been installed. This consists of a lime slaker, three causticizers, white liquor and green liquor clarifiers, a two-stage mud washer, dregs washer, lime mud storage tank, and lime mud 6 by 6-ft. Oliver filter. An 8 by 250-ft. Traylor lime sludge kiln was also added. Additional liquor clarifying capacity was provided to ensure clean white liquor for the digesters so that top quality clean pulp could be continuously produced independent of the liquor system variables. Augmenting the original oil storage tank, a new 45,000-barrel oil tank has been added.

Electrical System

The 13.8-kv. primary power distribution system is supplied from two 16,000-kva. transformers, which step down the 138-kv. supply from the B. C. Power Commission hydroelectric plant at Campbell River. A new 138-kv. transmission line has been built to replace the former 60-kv. line which supplied the original mill. The average power load has been increased from 7700 to 14–15,000 kw.

A 1250-kva. G. E. turbogenerator is being installed and will be used as an auxiliary power supply during shutdowns, etc

Water Supply

In order to provide additional water for the mill, a pumping station was installed at the Nanaimo River, augmenting the

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supply from the well system already installed. A second pipe line (50 in. diam.) and storage tank were constructed to bring the additional water the 6 miles to the mill.

In order to even out the flow of water in the river a million dollar project was completed at one of the lakes feeding the river. A storage dam was built to provide a reservoir that would supply water during the low periods of run-off.

Weyerhaeuser

In September the magic spark of electricity set in purposeful motion Weyerhaeuser Timber Co.'s ultramodern kraft pulp mill near the mouth of the Snohomish River.

The new mill went into production after more than 2 years of construction. Basically, this plant employs 200 men and women to produce about 250 tons of bleached kraft pulp each 24 hr. However, there is a great deal more to the significance of this complex plant than that.

Using Douglas-fir chips from the company's two Everett sawmills and from Weyerhaeuser sawmills in Enumclaw and Snoqualmie Falls, the kraft mill will operate without a single extra tree being cut from company tree farms. The chips are made from leftover edgings and trimmings, meaning a further step toward the company's goal of using the most of every tree harvested.

The symbol of that utilization is the shiny aluminum-jacketed conveyor which snakes its way from Mill B's chattering chippers to the kraft mill's chip-storage silos. Longest conveyor of its type anywhere, it goes through the lumber division's plant site, ducks under the Snohomish River bridges, and ends a mile and a quarter from where it began.

Mill C is also connected to the conveyor system. Chips from Enumclaw and Snoqualmie arrive in specially designed railroad cars. Several years ago, these sawmill leftovers were chopped into hog fuel, but today this material becomes the valuable raw material for wood pulp.

Why was this plant built in Everett? The men who ought to know say that four things are needed for a pulping operation: men, wood chips, power, and water. Those conditions are more than abundant in Everett which, with two Weyerhaeuser pulp mills, the bayside Scott Paper Co. expansion and the Simpson operation in Lowell, is becoming one of the nation's major pulp and paper producing centers.

Forest products built Everett and they are still adding to the Snohomish County industrial potential. Today's efficient forest products plants are bringing Everett a stabilized economy never dreamed of a quarter-century ago.

Weyerhaeuser's new kraft mill employs 200 men and women, with a total annual payroll of about $1,000,000. An industrial payroll like that has an expanding effect. Average national statistics indicate that 200 industrial jobs will support between 1333 and 1600 people in a community. This calls for 400 homes and will put 427 automobiles into the community.

Twenty-four schoolrooms will be filled; 44 stores will be needed; 32 professional people—doctors, lawyers, dentists, etc.—will be required to serve in the community. Each year $70,000 will be paid to local transportation facilities to carry goods produced. The 200 industrial jobs will buy the produce of 80,000 acres of farms. A revolving payroll of the new industrial jobs and the jobs created to serve them will add up to more than $3,000,000 a year.

Weyerhaeuser found most of the skilled men for its new mill in Everett, promoting men from its bayside sulphite mill to better jobs in the kraft mill and hiring other skills from the county area. Other men were transferred to the new plant from other company pulp mills where they had had valuable training and experience.

Wood chips for the new mill come from bark-free logs cut in company sawmills. Each of these sawmills is supported by certified tree farms, which, barring disaster by fire, disease, or insect invasion, are capable of producing timber harvests forever. Tree farm management in forest lands provides protection from the trees' enemies and includes natural and artificial regeneration of harvested areas.

Power for the kraft mill comes from an ingenious system of recovering the portions of the wood which cannot be made into pulp, removing the excess moisture, and burning the residue in special furnaces. Oil will also be burned in the powerhouse. Steam for driving turbines will be created, and the mill will produce all its own power requirements.

Water—25,000,000 gal. of it each day—is tapped from a point 6 miles up the Snohomish. The water there is essentially salt-free from tides the year around. Pulping is termed a "wet" process and demands chemically pure water. The amount of water treated daily in this new plant would supply all the nonbusiness needs of a city of more than 275,000 persons.

Chemicals for cooking and bleaching the pulp come from all parts of the nation, as described later.

Pulp and paper as a Pacific Northwest industry began in 1866 in a small mill at Oregon City. During the 1870's another mill was established in Oregon. Then, in 1883 Washington's first pulp and paper mill began producing newsprint and carpet paper at Camas. Washington last year produced more pulp and paper products than any other state. There are now 33 primary pulp and paper mills in Washington and Oregon, plus many converting plants which take pulp and paper and fashion it into trainloads of specialty items: frozen food containers, envelopes, paper twine, automobile seat covers, corrugated paper cartons.

During the pulping process strict quality control is necessary. Beginning in the plant's filtering phase, where the water is treated and all impurities removed, there are nine tests made every hour. Another of the mill's departments runs 21 tests for quality every hour. The bleaching operation undergoes 35 hourly tests.

There are 25 control reports due from the digester section each hour. The liquor makers have 74 hourly checks and tests to make. In the powerhouse, a maze of dials and controls, 62 hourly readings and reports are made.

And, there are 10 major quality-control tests run on the final product before it can be baled and shipped to the customer.

Even a plant as efficient as this one discharges some wastes, mainly used water. All water, including that from floor drains, after use goes into a sour sewer. This is piped underneath the Snohomish River to an earthwork settling basin on Smith Island. The basin can retain more than two days' water production. Water from this basin is released only on outgoing tides, when the river sweeps downstream and out into the deeper waters of Puget Sound.

Mill wastes going into the sound are far below any concentration which could kill marine life even under the worst circumstances. Both the State Pollution Commission and the State Dept. of Fisheries have been consulted on this disposal method.

A kraft mill is comparatively inoffensive as far as water pollution is concerned, as the chemicals used in the process are recovered and reused. The material dissolved from the wood is burned, so none of it goes out as a waste.

The basin discharge is controlled by the mill's shift chemist who operates its remote-control gates. He watches tide tables carefully. The waste water goes into Steamboat Slough, the swiftest flowing arm of the Snohomish. The mill's advanced design includes precautions against air pollution.

In design and engineering, the new kraft mill scores in several other advanced features. It has the first all-automatic water-filter plant. About 25,000,000 gal. of water are treated daily—and all this is done with electronically controlled equipment. If anything goes haywire, an alarm will sound, and a trained operator will investigate.

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The kraft mill was designed and built as an integrated unit. All pulping processes are near each other and can operate with a minimum of trouble. Digesters, bleaching plant, and washers are located on the same operating floor. Most kraft mills are far less compact, with these various operations many times in separate buildings.

All pulp in the kraft mill is dried under vacuum, so that it retains maximum quality and strength for papermaking after shipment to customers.

This mill represents the ultimate in forest-harvest utilization. Not a single extra tree will be felled to feed the ever-hungry digesters. The chips it pulps were formerly used for hog fuel in the four company sawmills which supply it. This plant converts a former low-value sawmill leftover into a high-quality, high-value papermaking wood pulp.

The new plant's 200 men and women are a hand-picked force, and the majority are long-time Snohomish county residents. During the past 3 or 4 months R. E. B. Wood, pulp division personnel manager, has interviewed and screened many applicants. He was assisted this Summer by Chuck Smith, Everett High School's assistant principal.

From the mill's organization chart, employee job titles sound as if the kraft mill is an unbelievable organization embracing the functions of a laundry (bleach operators), a distillery (liquor makers), a restaurant (digester cooks), a farm (balers), and the British Indian army (lancers, who are powerhouse employees). The skills are varied, as are the jobs themselves.

Directing Weyerhaeuser's pulp division of five mills in three Oregon and Washington communities is vice-president, Howard W. Morgan, whose headquarters are in the company's Tacoma offices. The firm's Everett pulp mills are managed by R. J. LeRoux, and the new kraft mill is superintended by Mr. Willins.

There are four major departments in the kraft mill: production, technical, maintenance, and powerhouse.

Whenever a new plant goes into production, many new and better job opportunities are created. Thirteen of the plant's key personnel were transferred from Weyerhaeuser's Longview, Wash., pulp division; 4 came from the company's Springfield, Ore., kraft container board mill, and 40 were shifted from the company's bayside sulphite mill to the kraft mill. Those men were promoted to jobs with more responsibility and higher pay. The rest of the employees were recruited in the local labor market, thus affording new jobs to people in the community, many of whom had never worked in a pulp mill before.

Weyerhaeuser furnishes its own wood chips—mainly from the chippers at Mills B and C in Everett, with lesser amounts coming by rail from company sawmills at Enumclaw and Snoqualmie Falls. The company's Everett lumber and pulp divisions are backed by Vail-McDonald Tree Farm of more than a half-million acres of timberlands in western-central Washington. Managed on a perpetual-yield basis, Vail-McDonald is equipped with modern harvesting and transportation gear and is acknowledged to have an outstanding fire prevention and suppression program.

The last 10 to 15 years have seen a revolutionary change in forest products manufacture, aimed at getting the most from every log going into the mill. Likewise, the efficiency of logging and transportation has been greatly increased.

Fallers and buckers are almost exclusively using gasoline-powered saws—so that the woods near the base of Mt. Rainier sound like an outboard motorboat meet. Powerful tractors and diesel-driven yarding equipment bring logs from the stump to the landing. There shovel loaders quickly pile logs onto waiting diesel log trucks, which run on private, company-owned roads for their 10-ft. bunks are too wide for public highways.

At the reload station, the entire truckload is transferred as a unit to railcars. The log trains, powered by diesel-electric engines, come down the hills and converge at the company dump at South Bay, near Olympia. The logs are dumped into the Sound, rafted, and towed to the Everett mills. So each log coming into Weyerhaeuser's Everett mills has had a trip of approximately 150 miles.

Logs coming into the mills are barked hydraulically. This has two distinct benefits: one, the sawyer is better able to size up a clean log for its breakdown into lumber; and pulp chips made from leftover wood must be bark-free.

Logs coming into the company's Enumclaw mill are from the White River Tree Farm, and Snoqualmie Falls logs come from that operation's surrounding tree farm.

The 25,000,000 gal. of water needed by the kraft mill each 24 hours is tapped from the Snohomish River. Six miles upstream, Weyerhaeuser sucks in the water and takes it to the kraft mill filter plant in a special pipe line. There it is purified with alum from Vancouver, Wash., and with chlorine made in Tacoma.

Chlorine used by the kraft mill for both water treatment and bleaching and caustic soda are produced electrolytically from salt evaporated in basins on the shores of San Francisco Bay. The salt is shipped to Tacoma for processing, as Tacoma can furnish the great amounts of power needed for the process.

Sodium sulphide, one of the chemicals used for cooking the pulp, is mined from a prehistoric rock-salt deposit near Niagara Falls, N. Y. This "salt cellar" is 1000 ft. under the earth's surface and is considered the world's largest salt mine. It is drilled out much like coal in this all-electric mine. The sulphur added after an electrolytic processing is mined in Texas and shipped to New York State.

Salt cake (sodium sulphate), another cooking chemical, begins its trip to the Weyerhaeuser kraft mill from Searles Lake, 130 miles northeast of Los Angeles. This lake covers a 12-sq. mile area and is just next door to Death Valley. Geologists believe the lake was nearly 400 sq. miles in area several thousands of years ago and was originally supplied with water from glacial streams. As time passed, the climate became warmer, ice caps receded, and the water stopped flowing. A drought set in. The extent of the lake diminished and the minerals dissolved in its water were deposited as sodium and potassium salts. The lake was discovered in 1862 and, soon after, it began furnishing raw materials to a borax refinery. Today a large integrated refinery extracts several commercial products from the prehistoric cache: common table salt, salt cake, muriate of potash, soda ash, and borax.

Lime, also used in the kraft cooking liquors, is quarried from a deposit on Blubber Bay in the Straits of Georgia, north of Vancouver, B. C.

Fuel oil for the plant's powerhouse is shipped from Texas in tankers and transferred into 9000-barrel barges in Seattle for the trip to Everett.

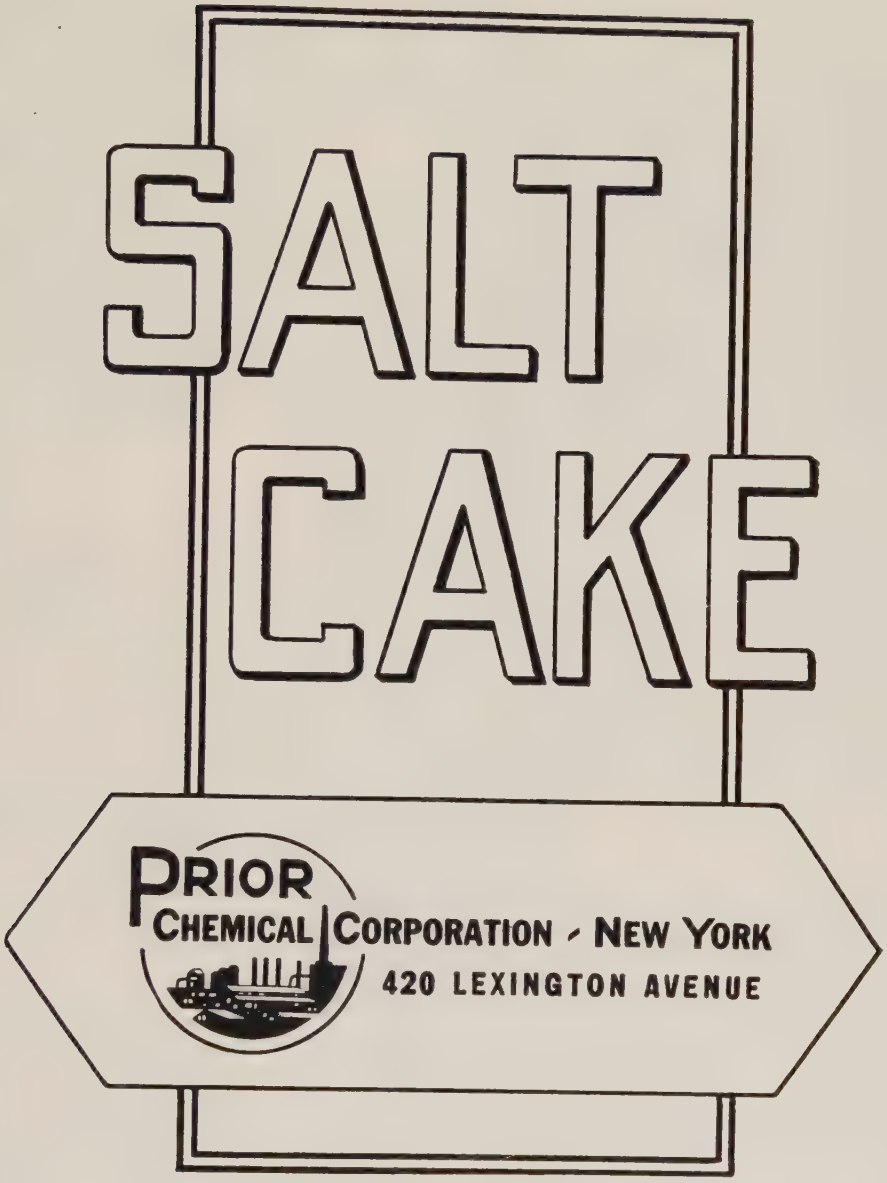
Steam and electricity are both generated in the plant's powerhouse. Fuel oil and the material recovered from the cooking process (with the chemicals removed and put back into the process) are used to fire the boilers. The two generators create 12,500 kw.

Even the wire with which the pulp packages are baled has a long trip to Everett. Some of the steel comes from Sparrows Point, Md., and some from Duluth, Minn.

People at the kraft mill say that there have been many questions about the chip conveyor belt and the plant's stack. The mile-and-a-quarter-long aluminum-covered conveyor is the lengthiest of its kind, anywhere. Altogether there are 12,073 ft. of rubber belting in it.

The stack is 275 ft. high; it sits on 476 pilings; it contains 475 cu. yd. of concrete; and it has a 12 ft. i.d. at the top. The bottom of the stack is used for salt-cake storage and will hold approximately 400 tons.

R. M. Inkster, Weyerhaeuser's Everett purchasing agent, has been more than busy in finding materials with which to build and to supply the mill. He said, "Just to get the mill into operation has taken about 30 railcars of various materials.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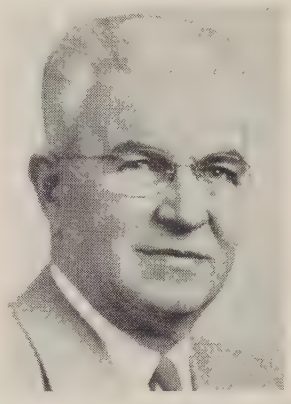
While we have purchased materials, motors, gages, dials, and more kinds of pipe and electric wiring than I ever knew existed from all parts of the country, all the lumber and timbers in the new mill came from right next door at the lumber division—that was the least of our worries."

NEPCO

Due to the death of Walter A. Radke, vice-president and treasurer of Nekoosa-Edwards Paper Co., Port Edwards, Wis., the board of directors of the company realigned management at a special meeting Saturday, September 12. In addition to their present duties as vice-presidents, Samuel A. Casey was appointed treasurer and Neil E. Nash was appointed secretary of the company.

S. A. Casey, Nekoosa-Edwards Paper Co.



N. E. Nash, Nekoosa-Edwards Paper Co.

Albert S. Puelicher, president of Marshall & Ilsley Bank, Milwaukee, was named vice-chairman of the board of directors. John E. Alexander, president and general manager, declared that the board had by resolution expressed its deep regret at its loss of Mr. Radke, both as a business associate and friend.

GAIR

The Gair Cartons Div., Piermont, N. Y., of Robert Gair Co., Inc., New York, received the Director's Safety Award of the Folding Paper Box Association of America for its record of 1 million man-hours without a lost time accident in its box shop. The award was presented by Edward Murphy, executive director of the Association, and accepted by Harry Van Decker, division manager of Gair Cartons.

ST. REGIS

St. Regis Paper Co. announces the award of undergraduate scholarships in forestry to William Echols Ball, Jr., U. of Wash., Donald Thomas Lester, U. of Maine, Donald Erskine Smith, Alabama Polytechnic Institute, Benjamin White Redding, U. of Fla., and Jack Barker Smith, U. of Georgia.

These scholarships are awarded under the scholarship program established by St. Regis for the academic year 1953–54. Three undergraduate scholarships are available in the South, and one each in the Northwest and Northeast. A Fellowship in Forestry was awarded in April of this year.

The St. Regis scholarships each amount to $800 a year for a period of 2 years and are awarded to the outstanding Junior student at the University of Washington, University of Maine, Alabama Polytechnic Institute, University of Florida, and the University of Georgia.

The company will offer to each of the undergraduate scholarship winners employment during the intervening Summer on some forestry project. Their continuance as recipients during the Senior year will depend upon their records in the field as well as in school.

More than a million consecutive man-hours without a lost time industrial injury have been completed by the Panelyte Div.'s Kalamazoo, Mich., plant. In the 18-month period from February, 1952, to September, 1953, a total of 1,049,890 consecutive accident-free man-hours was achieved.

This is the second St. Regis plant to achieve more than a million consecutive accident-free man-hours. The St. Regis printing paper mill at Kalamazoo won the National Safety Council's Award of Honor for having operated a total of 1,009,116 man-hours without a disabling injury in 1952.

Approximately 1500 service pins will be awarded by St. Regis Paper Co. this year to employees who have been with the company for 5 years or more. Presentations will be made of pins denoting 5, 10, 15, 20, and 25-years of employment in the mills, plants, and offices of all divisions of the company.

A four and one-half million dollar expansion program at the St. Regis Kraft Center in Pensacola, Fla., has been announced by St. Regis Paper Co. This expansion program, scheduled to be completed by July 1, 1954, is designed to increase the flexibility of the Pensacola Kraft Center so that it can produce bleached and unbleached grades of kraft paper for a broad variety of uses. Tidewater Construction Co., Norfolk, Va., is general contractor for the new facilities.

The expansion program consists of four major parts: construction of a six-stage bleaching plant, increased water supply facilities, a screen room extension to increase screening capacity; and modernization of the no. 1 paper machine for the production of bleached fourdrinier grades. Location of the new bleaching plant will be on the no. 1 pulp mill site in the area east of the present bleaching plant.

RHINELANDER

Pulp and Sap Peeling

Sap-peeling time in the forests of Ontario comes at a pretty fair time of the year. It starts in the late Spring and ends in mid-Summer, and if a fellow manages to duck the black flies and mosquitoes, he figures he's doing okay.

Like Winter hauling in the muskeg country, sap peeling is pretty much a race against time. It generally gets under way about the middle of May and stops around the end of July.

Between May and July about 60,000 cords of peeled birch, poplar, spruce, and balsam will have been sap-peeled in Ontario—all of it to be hauled by rail to pulp and paper mills across the border.

Ripco Timber Co. at Hearst has 110 men working on sap-peeling operations this season and are producing their quota of 5000 cords. This peeled wood will be hauled during the Winter months and shipped by rail to Rhinelander Paper Co. in Wisconsin for processing into glassine and greaseproof papers.

Sometimes during the month of May the sap starts to flow. This period varies with the years and locations, but depending on the weather, it usually starts between the 10th and 20th of the month, especially in the Hearst area in the spruce and balsam.

As soon as the sap flows in the trees, the sap peeling begins. The rough wood is felled, branched and then cut into 8 or 4-ft. sticks and by noontime, enough wood has been cut to start a day's peeling.

The tools required consist of an axe and a "spud." This spud is a bar of iron (or in some cases a piece of water pipe) which has been flattened at the end and curved upward. It looks somewhat like the tool used to pry a tire off the wheel of a car, except that it is smaller in length and the blade is thinner, thus giving it a cutting edge.

When the peeler begins his job, he first takes off a strip of bark from one end of the stick to the other by means of his axe. This strip is from $1/2$ to $1\,1/2$ in. in width.

Next, the axe is embedded in one end of the stick in order to use it as a lever working the stick to and fro while the spud is inserted between the bark and wood and removes the bark.

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PAPER
BAGS
WADDING
BOOK PAPER
WALL BOARD
WALL PAPER
GLASSINE

When the bark is taken off, it is always placed face downward so as to prevent accidents which could easily be caused by the slippery side.

The pulpwood bolts, freshly peeled, are then left in the stip to dry. It would be disastrous to attempt to pile the wood as soon as it is peeled because it is so slippery.

The peeling season in the Hearst area lasts about $2^1/_2$ months and thus the cutter doesn't have to pile as soon as he's peeled. He peels as much wood as he can and only piles it when the sap-peeling season is over. According to statistics compiled from many sap-peeling seasons, it is found that a cutter averages 1.1 cords a day, but a few men who are experts at it, can produce 2 and sometimes 3 cords a day.

It is estimated that the dried sap-peeled wood weighs about 3000 lb. to the cord as compared to 4500 lb. for rough green pulpwood. The saving in freight costs is therefore considerable under the present high freight rates scale. In addition, sap-peeled spruce pulpwood, for example, makes a cleaner pulp stock which is practically free of pitch; and the sap peeling in the bush cuts out the need for bark disposal at the mill.

Pulpwood from Saskatchewan

Most people visualize endless expanses of wheat fields on flat, windy prairies when they think of the Prairie Province, Saskatchewan. However, a large part of the northern half of the province is covered with timber, and very good timber at that.

This Winter, for the first time, our mill will run peeled spruce from the prairies. The spruce forests of Saskatchewan are not as extensive as those of Ontario, and the supply of black flies and mosquitoes must have run out just before the Saskatchewan quota was allotted. After becoming somewhat accustomed to the flies in Ontario, it was a real pleasure to find so few in Saskatchewan.

An appreciable part of the labor going into the production of our "prairie wood" is supplied by Indians who bring their tents and families directly to the job and do their cutting practically in their own front yards. These Indians cut wood during the Spring, Summer, and Fall and then pack their families off to the trapping grounds for the Winter months. These people are, by our standards, "uncultured," and "uneducated," yet they bring up their families in the deepest parts of the bush country with the aid of a bare minimum of the necessities that our civilization demands. They appear to be much happier in their comparative freedom than our own reservation Indians who are under the protection and care of the Great White Father in Washington.

Distances are great in the comparatively undeveloped area in which our wood is being produced; a recent wood-inspection trip required almost 1000 miles of auto travel to cover an area cutting only about 5000 cords of wood this season. Highways are all gravel or just plain prairie soil that is very similar to an ocean of pancake batter when wet. The walking, however, is excellent.

The business of producing pulpwood is very new in Saskatchewan, the first pulpwood being cut in 1937. This year, Rhinelander Paper Co.'s order for peeled spruce is the largest order in the province. The famous old wheat country names of Regina, Moose-jaw, and Saskatoon are not matched by names of great logging centers such as we have in Wisconsin. However, in the future, such names as Hudson's Bay, Bannoch, Mountain Cabin, Reserve and Fir River may be well known in the timber-producing area.

RICHMOND

The first commercial application of semichemical pulp to replace the major portion of sulphite in newsprint is taking place at the Richmond Pulp & Paper Co. of Canada, Ltd. at Bromptonville, P. Q. Since its purchase in 1950, the mill has been modernized and enlarged. A semichemical pulp mill has been added, and a high speed newsprint machine, two new grinders, a new barking drum, and new screens have been installed, as well as a new water filter.

The mill uses spruce, birch, and poplar, delivered mostly by rail, although some truck shipments are received. The spruce is used exclusively in the groundwood mill and is barked at the mill. The birch and poplar go to the semichemical mill and are received, at the moment, in a peeled condition. The economy of the mill is based on the use of hardwoods in the semichemical process.

It is claimed that a ton of pulp made by the high-yield semichemical process from high density hardwoods requires much less than the 2 cords of softwood required in the sulphite process.

The semichemical process used consists of the unit operations of chipping, cooking (in an insulated rotary spherical digester, 16 ft. in diameter) refining in a disk refiner, and screening.

The semichemical plant has a potential capacity of 25 tons per day and is currently producing about 20 tons per day.

Most cooks to date have been made using poplar, although one or two experimental cooks of birch have been made, with excellent results. Eventually the two species will be cooked together, in varying mixtures, without having the wood segregated beforehand.

Two grades of semichemical pulp are turned out; production of the first grade involves using technical grade sodium sulphite and soda ash, and the second uses sodium sulphite and liquid caustic soda. The first grade is used in the newsprint produced at the mill, while the second grade is lapped, baled, and shipped to a nearby small mill producing corrugating medium.

Appropriate quantities of the chemical required (sodium sulphite and sodium carbonate for the neutral sulphite cook—sodium sulphite and caustic soda for the alkaline cook) are in the dry form dumped into the digester after the chips are added and a measured quantity of water is introduced. The chemical charge for the neutral sulphite cook consists of 20% sodium sulphite and 4% soda ash, based on the weight of oven-dry wood.

The digester is then sealed and steam added. The digester rotates at one revolution every 2 min. A manual cooking cycle is followed, reaching a maximum pressure of 125 p.s.i. and temperature of 338°F. The digester cooking cycle is approximately 7 hr., including 1 hr. for filling and 1 hr. for dumping. At present there are three cooks a day, producing about $6^1/_2$ tons per cook. When the cook is complete, the digester is relieved to atmospheric pressure and the cooked chips are emptied into a dump tank immediately below the digester. There is no liquor recovery. After drainage, the moisture content of the chips is about 50%.

The chips are removed from the dump tank by a conveyor and fed to the refiner by a variable speed screw conveyor above the refiner with an "overflow" back to the dump tank. The chips entering the refiner are diluted with hot water (operating experience has shown that the hotter the dilution water the better the results) to a consistency of 6–8%. Screened yield of the neutral sulphite semichemical averages about 72%; the alkaline semichemical runs around 76% yield.

When both newsprint machines are operating, the semichemical pulp is used in slush form. Its consistency is controlled by a Trimbey consistency regulator and it is then passed through a beater where purchased sulphite pulp is added. The mixed chemical pulps are then combined with the groundwood pulp in a stock proportioner to form the furnish for the machines, which consists of about 85% groundwood, 10% neutral sulphite semichemical, and 5% purchased sulphite. It is believed possible that, as operating experience is gained, the sulphite now added will be entirely replaced by semichemical pulp.

When only one machine is operating, the semichemical pulp

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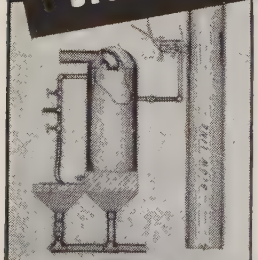

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is lapped on four of the wet machines and sold, or added to the beater in lapped form with the sulphite.

Baie Comeau

Manicouagan Power Co.'s new $15 million hydroelectric power development on the Manicouagan River was officially opened recently. The plant includes two 45,000-hp. generators.

It will supply reserve power for the pulp and paper mills at Baie Comeau, for the community and for new industries growing up, or expected to grow up, in the area according to *The Financial Post*, August 8.

Manicouagan Power Co. is a wholly owned subsidiary of Quebec North Shore Paper Co., which in turn is controlled by the Chicago *Tribune*. At the opening, it was indicated that surplus power from the new development might someday be used for a new paper machine.

Gair Woodlands

A substantial revenue, in addition to that produced from growing trees and cutting them for pulpwood and sawtimber is secured by Gair Woodlands Corp. annually from naval stores or turpentine operations carried on in the corporation's forest areas in Georgia and Florida which lie in the heart of the turpentine belt.

The working of pines for naval stores purposes does not greatly retard the growth of the trees, and the newest type of turpentine working, called "bark chipping with acid stimulation" does not damage the butt of the tree beyond use for pulpwood, sawtimber, or poles.

Turpentine operations in woodlands decrease the chance of forest fires, since the naval stores workers are active in the woods during most of the year. In addition, incendiarists are less likely to set fire to timber which local people are working for turpentine purposes. When fires do occur, the woods labor is immediately available to help extinguish them.

The fact that Gair Woodlands Corp. is interested in carrying on turpentine operations, which give employment to local labor and also give income to the local businessmen who rent the turpentine rights on the corporation's land, brings about better appreciation by the local people of the corporation's forest management program.

The production of gum from pine trees for naval stores purposes is accomplished by a system of "chipping" or "streaking" "faces" on the growing pines periodically to keep the pitch or "gum" running from the tree. This streaking is started at the base of the tree by removing a strip of bark or "streak" about $1/2$ in wide horizontally, for about one third the circumference of the tree. This streak is cut with a curved scraper or "hack" which is pulled across the face. To keep the pitch or gum running, new streaks are cut above the first, at one or two-week intervals throughout the season during which the tree is growing. In the south, this growing season extends from March until late October.

To collect the gum as it runs from the streak, a spiral metal gutter is fastened at a slant beneath the face, and a square metal cup into which the gum is directed is hung below the gutter. The gutter is attached to the tree with unusual double-headed nails which can be pulled out and reused. The cup is propped up on large nails which hold it beneath the gutter just off the ground at the base of the tree. Regular nails left in the tree would damage saws used for cutting the timber later, would damage headsaws used for sawing logs into lumber, and would damage chippers at the pulp mill which cut the pulpwood bolts into small chips for cooking in papermaking.

Up until the last few years, streaks were put on the trees weekly with a wood hack and each streak cut nearly $1/2$ in. deep into the wood of the tree as well as $1/2$ in. or more up the tree. During a working season, 32 streaks at weekly intervals would

use up 16 to 20 in. of face and four working years would raise the face to about 6 ft. from the ground. Cutting into the wood would also make the area covered by the face of little value when the tree was finally cut. Also, pitch accumulated on its rough surface would cause serious burning and charring when the face was exposed to fires.

Recently a method was developed of merely stripping the bark from the tree for each streak without cutting into the wood, and then spraying sulphuric acid on the exposed wood or "cambium layer." This stimulation by acid will keep the gum running for 2 weeks, as compared with 1 week for a streak cut into the wood without acid. The use of acid, therefore, produces as much gum with half as many streaks. It uses up the face only half as fast and it gets the gum from the tree without cutting into the wood and seriously degrading the butt of the tree worked.

The gum which has collected in the cup at the base of each worked tree is dipped out at 3-week or monthly intervals by a woods laborer who dumps it into a collecting bucket. Contents of the collecting bucket is dumped into a barrel which is transported to a gum processing plant where the gum is distilled into turpentine and rosin for use by various American industries.

Trees to be worked for naval stores products are leased, for periods of 1 or 2 years or more, to local turpentine operators who are given the right to work trees above certain minimum sizes, or those trees which may be specifically marked for working, in return for payment to Gair Woodlands Corp. of a certain percentage of the total value of the gum produced from the trees during the period of the lease. From 20 to 50 trees per acre may be leased, and an operator may lease a few thousand trees or fifty or one hundred thousand trees depending on the forest condition existing and on the size of his own organization.

In the turpentine belt, timber grows fast, and cuttings are made at 4 to 10-year intervals in fully stocked timber stands depending upon the growth and condition of each stand. The company usually selectively marks timber for turpentine operation 3 to 5 years in advance of actual cutting, and the trees are worked for turpentine until the time comes to cut them.

American Turpentine Farmers Association Journal of Valdosta, Ga., says: "This type of cooperation and work between two different timber-using industries accomplishes much toward creating a better appreciation of sound forestry practices. It also demonstrates that land acquired primarily for production of a specific product can be made to grow that product and at the same time through integrated management produce additional revenue and good will for the owner."

In its policy of maximum production for its timberland, Gair Woodlands Corp. sells practically every forest product its land produces, and makes a concerted effort to market these products to residents of the local communities in which holdings are located. One of its aims is to do busines with as many individuals as possible in order that people may become better acquainted with the company and its land management objectives.

Publishers' Paper

Two 60,000-gal. tank loads of sulphite liquor from the Publishers' Paper Co. at Oregon City, Ore., have been barged down the Willamette River and dumped in the larger faster-flowing Columbia River, below Portland, as another step in the company's $150,000 experimental program aimed at compliance with the state law forbidding pollution of Oregon streams by disposal of industrial wastes.

The initial barge shipment, said S. J. Robinson, vice-president and general manager of the company, was an "exploratory run." At the confluence of the Willamette and the Columbia, the mill waste was released slowly into the swift,

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deep current of the latter stream, and was expected to be diluted sufficiently to prevent any serious pollution of the water.

If reports on the procedure are satisfactory, as company executives expect they will be, a second tank barge will be built, so that one can be loading at the mill moorage while the other one is making the 8-hr. round trip down the river. Each tank is 105 ft. long and 10 ft. in diameter.

Much of the mill's daily run-off of some 240,000 gal. is being used by the county for dirt road surfacing.

St. Lawrence

Vernon L. Tipka has been appointed a vice-president and a director of the St. Lawrence Paper Corp., Norfolk, N. Y. Formerly he had been assistant to the president, James L. Knight. The newsprint producing mill of the company is located at Norfolk.

Alaska

The Office of Defense Mobilization issued, the latter part of August, a certificate of necessity for $54,174,090 to the Georgia-Pacific Plywood Co. of Juneau, Alaska, for the manufacture of newsprint. Of this amount, 40% was allowed for accelerated amortization.

Union Bag

Union Bag & Paper Corp.'s Box Div. is producing a new corrugated container for packaging 40 lb. of tomatoes. Advantages of the new package are: only two stitches are required to set up the box, it is easily closed due to wedge-shaped cuts on the side flanges of the cover, and the sulphur-impregnated corrugating medium eliminates bulging of the side-walls.

Lindenmeyr

Henry Lindenmeyr & Sons, 480 Canal St., New York, N. Y., have published booklets on "How to Prepare Copy for Die Cutting," "How to Order Paper Properly," and "Printing Types and Printing Paper."

NPTA

The National Paper Trade Association, Inc., 220 E. 42nd St., New York, N. Y., has issued a publication "The Costs of Storing, Handling, and Delivering Paper," containing the results of a survey of this subject among 46 firms.

Tree Farms

Data issued by the American Forest Products Industries, Inc., show that there are 4587 tree farms in the United States, covering 28,632,189 acres. The largest number of tree farms is in Texas, covering 3,292,332 acres. The 11 southern states account for 2431 farms, covering 16,768,089 acres.

Community Relations Check-up

A corporation with plants in many widely scattered cities and towns recently sent its plant managers a memorandum on community relations in which it asked these questions:

How long since you've sent in an item of news to your local paper about your plant and the folks who work there?

When was the last time you took your editor or reporter out to lunch or dinner just to chew the fat about items of interest to both of you?

Do you have one man designated as plant spokesman, and is his responsibility known in the plant and to the press?

Have you ever had a plant visit and open house for your employees and their families? If not, is it on the agenda for consideration this year?

Ever have a community open house? Is this a good year to hold one?

Do you give a pat on the back occasionally to associates who are doing a good job in community affairs?

These are good questions for any company to use as a check-up in their plant communities.

Greeting Cards

The printed greeting card is neither new nor a product of American invention. During the 15th and 16th centuries greeting cards decorated with woodcuts were widely used in Europe.

Credit for printing the first commercial Christmas card is generally extended to an Englishman, W. M. Egley, whose copiously illustrated and colored card was published in 1842. Nevertheless, a recent issue of *Life* Magazine states that it was Sir Henry Cole, another Londoner, who first printed and sold Christmas cards in 1846. Sir Henry, owner of an art shop, commissioned an artist to create the design, then ran off a thousand cards on a litho stone and had them colored by hand.

In the United States the first Yuletide cards appeared in Boston in 1856. They were made by a German exile, Louis Prang, who called his multicolor creations "Chromos." Since then the use of printed cards for all manner of occasions has grown increasingly popular until today they are sold in this country at a rate of almost a dollar a year for every man, woman, and child.

ESPRA

A new process for making stronger pulps from hardwoods at lower cost has been developed by the State University of New York College of Forestry at Syracuse.

Improvement of the semichemical pulping process is the second major result of hardwood pulping research at the forestry college, according to Robert M. Husband, research associate. In 1950 the college discovered the Chemiground-wood process, reportedly the first successful commercial method of making good, cheap paper pulp from hardwoods.

Research for both studies has been co-sponsored by the college and the Empire State Paper Research Associates, Inc., a group of 22 pulp and paper mills in the United States, Canada, Italy, France, and South Africa.

Bark Removal

Research on methods of loosening the bark of poplar pulpwood through the use of chemicals is being continued by the William Bonifas Lumber Co., a subsidiary of the Kimberly-Clark Corp.

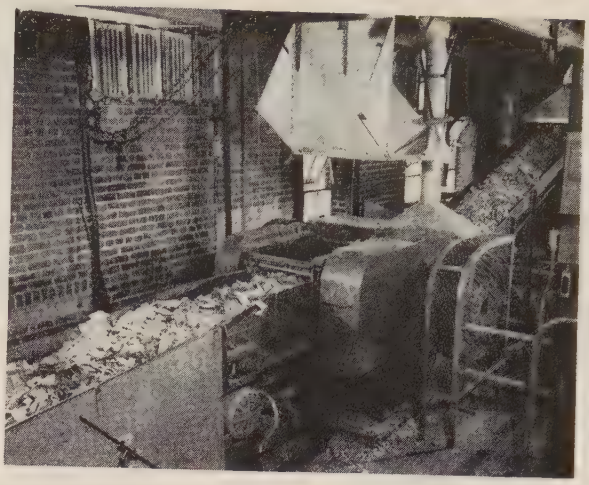
Chemicals that were found to be effective in other tests are being used again this year, but they are being applied in weaker quantities to determine the least amount of solution that is effective in loosening the bark. The firm hopes to reduce the wood discoloration that takes place when the chemicals are used full strength.

The chemicals are applied to newly exposed wood after the tree has been girdled during the season when the sap is running. The operator carries the mixture in a can on his back and feeds it through a hose to a brush for application to the tree.

"The purpose of these experiments is to loosen the bark from the pulpwood to expedite its removal in the drumbarker," a company forester said. "If wood quality can be maintained while doing this, we will be able to increase the use of poplar pulpwood in our mills."

Further tests are being made with chemical solutions mixed with each other in varying amounts. A combination of Ammate solution with a 2-4-5-T solution is being tried. Some of the chemicals are mixed with a blue dye, others with green so treated trees can be identified from nontreated trees.

The experiments are carefully controlled to guard against wildlife damage. Blue and green colors are being used this year, because a red color used last year seemed to attract wildlife to the area of treatment.



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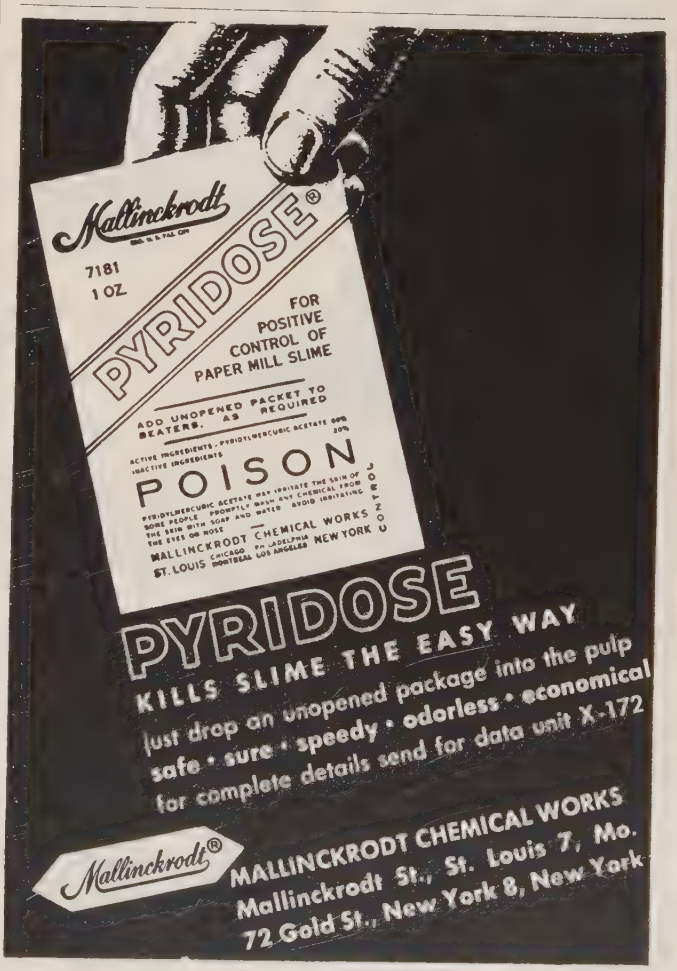
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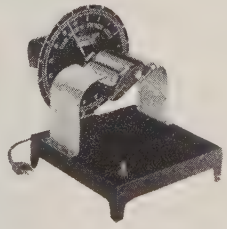

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Appearance of Paper

(Statement of Unsolved Problem by ASTM Committee D-6 on Paper and Paper Products)

Problem. The appearance of paper may generally be considered as one of its most important characteristics. The over-all appearance is a combination of many complex factors, psychological as well as physical. Some of these such as brightness, color, gloss, and opacity can be measured and approximately described by physical and optical methods. Others are much more elusive, for example "texture" means many things to different people although in the paper industry it may be considered as closely analogous to "finish." The problem of appearance can only be stated in the broadest terms since a complete and detailed discussion would require volumes.

Present State of Knowledge. The literature dealing with the many phases having to do with the appearance of paper is voluminous. Methods for reflectance, color, opacity, and gloss are in common use, but the interpretation of the results obtained especially when considered in their relationship to over-all appearance is difficult, probably because of the complications introduced by the psychological factors involved, as it applies to all materials. The problem of appearance is receiving the closest attention of ASTM Committee E-12 on Appearance.

Questions That Need to Be Answered. (1) Such terms as "gloss," "sheen," and "glare" should be defined in terms of actual instrument readings taking into consideration the incident angle and color of illuminant, as well as the color of the sample under consideration.

(2) The "brightness" of paper should be defined in terms of instrument readings taking into consideration the color of the illuminant, and the "gloss" and the color of the sample.

(3) The "texture" and "finish" of paper should be defined in terms of measurable properties as noted above.

(4) The "appearance" of paper should be described in such terms as to correlate with the "appearance" of other materials and surfaces such as plastics and textiles.

Introductory Reference. (1) "Paper and Paperboard: Characteristics, Nomenclature and Significance of Tests," Am. Soc. Testing Mats., Oct., 1951, especially Parts I, III, and IV, pp. 61, 74, 84, and 90. (Issued as separate publication, *STP No. 60-A*.)

Additional information may be obtained from W. R. Willets, Chairman of Committee D-6, Titanium Pigment Corp., 99 Hudson St., New York 13, N. Y.

Erasability of Paper

(Statement of Unsolved Problem Contributed by ASTM Committee D-6 on Paper and Paper Products)

Problem. Although several instruments have been adapted to measure this property (which is not clearly defined), and one especially designed for the purpose, there is a lack of correlation between different instruments and also a lack of correlation between the information thus obtained and practical application.

Present State of Knowledge. A great deal has been done in developing an instrument for determining erasability based on the work of Codwise and La Fontaine which utilizes the rubbing action of a "standard" silicon carbide cloth under "standardized conditions" in a mechanical abrading instrument. The instrument as originally developed has undergone various modifications in an effort to ensure the "standard" conditions. The number of instruments available for round-robin testing is exceedingly limited and to date such round-robin tests have not shown any great reproducibility between different instruments.

Questions That Need to Be Answered. (1) The present instrument covers only the erasure of standardized writing ink markings although the principle should be applicable to all

types of erasure work. Therefore the application of the test to other types of marking (for example, standardized typewritten characters) should be investigated and correlation with the standard writing ink markings studied.

(2) The optimum "standard" conditions for marking, abrading surface, pressures, rubbing, and the like, and whether these standard conditions can be maintained, should be determined.

(3) A satisfactory definition for "erasability" should be developed together with proper interpretation of results.

(4) There should be means of expressing not only the requirements necessary for the best retention of surface features after the removal of errors under standard conditions but also means of expressing the quality of the reinsertion of the same type of material with the least change in the appearance of either paper or copy.

Introductory References. (1) TAPPI Suggested Method T 478 sm-52, "Ink Erasing Quality of Paper."

(2) TAPPI Tentative Standard Method T 476 m-51, "Abrasion Loss of Paper and Paperboard."

(3) Codwise, P. W. "Determination of the Erasing Qualities of Paper," *Paper Trade J.* 120, No. 8: 136 (Feb. 22, 1945); *Tech. Assoc. Papers* 28: 69 (1945).

Additional information may be obtained from W. R. Willets, Chairman of Committee D-6, Titanium Pigment Corp., 99 Hudson St., New York 13, N. Y.

Formation of Paper

(*Statement of Unsolved Problem by ASTM Committee D-6 on Paper and Paper Products*)

Problem. The property of paper referred to as "formation" has been defined as the degree of uniformity with which the fibers and other solid components of the paper are distributed. It is usually judged by the visual appearance of the sheet when viewed by transmitted light. The type and degree of uniformity is a major factor not only in appearance but in determining the impregnation or absorption characteristics for resin, varnish, wax, oil, or ink. To date there has been no simple, inexpensive instrument available for designating formation numerically for all types of paper; in general, formation is described qualitatively as "wild" or "close," with qualifying adjectives. There is definite need for an inexpensive instrument which would permit numerical designation of different types and degrees of formation.

Present State of Knowledge. There are several instruments already available for measuring formation, such as the Davis-Roehr-Mahlstrom Photoelectric Formation Tester. However none of these has met the requirements for a universal instrument suitable for both manufacturers and consumers, although formation is always a property which is a consideration even though its description is usually qualitative and empirical and a matter of personal judgment and comparison with standards.

Questions That Need to be Answered. (1) There are different types and degrees of formation and these should first be clearly defined.

(2) The type and degree of formation should be numerical expressions. A suitable instrument should be developed which will furnish inexpensive and simple means for determining and expressing formation.

(3) Such an instrument should be adaptable for all types of paper.

(4) The formation, properly measured and expressed numerically as to degree and type, should be correlated with printing, impregnation, and other uses to which the paper is put.

Introductory Reference. (1) "Paper and Paperboard: Characteristics, Nomenclature, and Significance of Tests," Am. Soc. Testing Mats., Oct., 1951, pp. 74–75. (Issued as separate publication, *STP No. 60-A.*)

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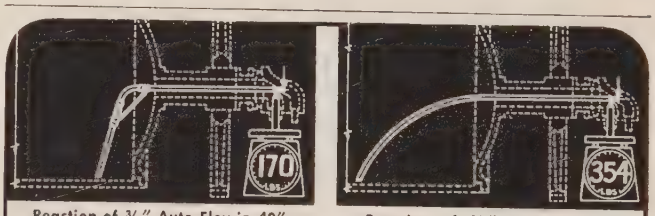

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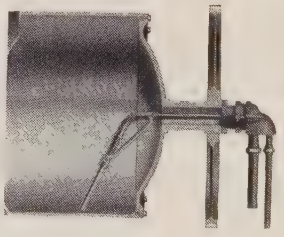

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Siliceous Grit of Paper

(Statement of Unsolved Problem by ASTM Committee D-6 on Paper and Paper Products)

Problem. The presence of abrasive particles in paper is a source of trouble because of undue wear on cutting and slitting equipment, wear and abrasion of printing plates and rolls, and defects in such functional papers as perforating grades of tapes.

Present State of Knowledge. A method for the determination of siliceous grit was proposed about 6 years ago, and has found some application although correlations between the results obtained and the actual abrasive properties of some papers have been very erratic.

Questions That Need to Be Answered. (1) The present procedure does not provide for the complete separation of certain mineral fillers which do not cause abrasion so that papers containing such fillers show erroneously high "siliceous grit" values although free of abrasive tendencies. Therefore the method should be improved so as to effect complete separation of the common loading materials while retaining the abrasive siliceous grit, for example, particles intact.

(2) Correlation between the siliceous grit content of paper and actual abrasiveness of the paper in end use should be obtained.

Introductory Reference. (1) "Proposed Method of Test for the Siliceous Grit Content of Paper and Paper Products," *ASTM Bulletin* No. 144: 48 (Jan., 1947).

Additional information may be obtained from W. R. Willets, Chairman of Committee D-6, Titanium Pigment Corp., 99 Hudson St., New York 13, N. Y.

Tension Testing of Paper

(Statement of Unsolved Problem by ASTM Committee D-6 on Paper and Paper Products)

Problem. The tensile strength of paper, both wet and dry, is an important property in many end uses, either considered alone or in conjunction with other properties such as stretch and elasticity which may be related. While present methods are probably satisfactory as far as they go they do not take into account newer types of instruments which make use of strain gages and other devices.

Present State of Knowledge. Tension testing was probably one of the first methods to be developed and the literature on it is copious. However, the relationship between tensile strength and stretch, elasticity, and other properties which are probably related has never been thoroughly investigated. Neither has the effect of repeated applying and releasing strain on a paper web on the ultimate tensile strength been determined. Correlations between tensile strength methods and results for paper and other thin sheet materials such as felts, flocs, films, rubbers, laminants, and textiles together with practical applications to end use where one might be substituted for another have not been developed. For this reason ASTM Committee E-1 on Methods of Testing has been requested to sponsor a symposium on the tension testing of thin sheet materials in 1954.

Questions That Need to Be Answered. (1) Investigate all types of tension testers, old and new, to determine their adaptability to paper and correlate results obtained.

(2) Investigate relationship between tensile strength and other properties such as stretch and elasticity.

(3) Determine the relationship between tests on paper and on other materials as they affect end use.

(4) Determine the effect of repeated applying and releasing strains on paper on the ultimate tensile strength in conjunction with other properties.

Introductory Reference. (1) "Paper and Paperboard: Characteristics, Nomenclature and Significance of Tests," Am. Soc. Testing Mats., Oct., 1951, p. 98; 106. (Issued as separate publication, *STP No. 60-A.*)

Additional information may be obtained from W. R. Willets, Chairman of Committee D-6, Titanium Pigment Corp., 99 Hudson St., New York 13, N. Y.

Chemistry and Utilization of Hemicelluloses

(Statement of Unsolved Problem by ASTM Committee D-7 on Wood)

Problem: To learn more about the chemistry of hemicelluloses and to find uses for the large quantities of hemicellulose residues of pulp mills that are wasted or used as an inefficient fuel.

Present Status of Knowledge. Information on the chemistry of hemicelluloses and the sugar decomposition products resulting from pulping operations is very limited. It is known that hemicelluloses can be broken down to sugars and part of them converted to furfural and that they can be used for growing yeast and chemical-producing organisms. Some of the dextrinlike products show adhesive properties.

Questions That Need to Be Answered. More information on the nature and chemical reactions of the hemicelluloses is needed as an aid in developing better and more extensive means of utilizing these stream-polluting chemicals.

Introductory References. (1) "Derived Products and Chemical Utilization of Wood Waste," *Report R1666-10,* U. S. Forest Products Laboratory, Madison, Wis.

(2) Wise, L. E., "Wood Chemistry," New York, N. Y., Reinhold Publishing Co., 1944.

Additional information may be obtained from L. J. Markwardt, U. S. Forest Products Laboratory, Madison 5, Wis.

Constitution of Lignin

(Statement of Unsolved Problem by ASTM Committee D-7 on Wood)

Problem. To determine the constitution of lignin in its native and various isolated forms.

Present State of Knowledge. Although information on the chemical reactions and nature of lignin is gradually being accumulated, we still lack any exact knowledge as to its constitution.

Questions That Need to Be Answered. We need to know the exact constitution of lignin isolated by different methods from various woods and annual plants to determine differences in lignin from various sources and the changes that occur during various isolation methods as an aid to lignin utilization.

Introductory References. (1) Wise, L. E. "Wood Chemistry," New York, N. Y., Reinhold Publishing Co., 1944.

(2) Brauns, Friedrich E., "Chemistry of Lignin," N. Y. Academic Press, New York, 1951.

Additional information may be obtained from L. J. Markwardt, U. S. Forest Products Laboratory, Madison 5, Wis.

Plant Maintenance

Fifty-nine conference sessions are on the program of the three-day Plant Maintenance and Engineering Conference at the Hotel Conrad Hilton, Chicago, January 25–27, to be held concurrently with the Plant Maintenance and Engineering Show, which is scheduled for the International Amphitheatre, Chicago, January 25–28.

The conference will open with a general session on "Planning and Scheduling Maintenance Work." On the morning of the third day, another general session will be held on "Maintenance Cost Control and Budgeting," and the conference will close with a 2-hr. question-and-answer period at which an effort will be made to discuss all previously unanswered questions.

Sectional conferences will be devoted to "Preventive Main-

tenance—Pros and Cons," "Training People for Maintenance Work," "Organizing People, Policies and Procedures for Effective Maintenance," "Sanitation—Methods, Materials, and Control," "Maintenance by Area Compared with Centralized Maintenance," "Work Measurement, Work Standards, and Incentives," "Getting Management's Okay on the Maintenance Program," "Problems Met in Handling Maintenance Labor," "Corrosion Control and Prevention," "Hospitals, Medical Departments and First Aid Rooms," "Card Record and Analysis Systems," and "Waste Disposal Problems and Solutions."

Round tables will be devoted to the special plant problems of eight industries. These include chemical plants, breweries and distilleries, food processing and packaging plants, paper mills and paper product plants, petroleum refineries, sheet metal plants, steel mills, and textile mills.

Particular types of equipment also will get special attention. These are materials handling, mechanical service, lighting, power plant, and electronic control equipment.

Other round-table subjects include "Inspection and Upkeep of Electrical Distribution Systems," "Handling Equipment and Methods of Handling Used in Maintenance Work," "Lubrication—Methods, Systems, Lubricants," "Maintenance Stores and Storekeeping," "Maintenance in Plants Having Up to 25 Maintenance Employees," "Maintenance of Plant Buildings," and "Janitor Work—Methods, Techniques, Organization, Control."

Advance registration cards and hotel information may be obtained from Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

Chemical Industries Exposition

Exhibitors at the 24th Exposition of Chemical Industries are paving the way to further expansion of the chemical and process industries, which are already among the Nation's greatest manufactures. The exposition will reflect the magnitude of chemistry and chemical engineering from a display of almost 500 exhibits covering nearly 5 acres. Housed at the Commercial Museum and Convention Hall at Philadelphia, it will run from November 30 to December 5, inclusive. Some 140 new exhibitors have been added to those returning from the last exposition, in New York, 2 years ago. It will be the largest of its kind ever held.

The display will comprise chemical substances, chemical materials, structural and protective materials and coatings, construction materials, chemical process equipment, material handling, production equipment, laboratory supplies, research and testing instruments and controls. Some 240 different classifications of exhibits are cataloged, with one to more than 100 exhibits listed in each class.

Chemicals represented range from rare and refined substances available only for research, through reagents for the laboratory to the commercial grades available in quantities. Materials are shown in rare and fabricated forms and in parts shaped to customer specifications. Specialities, such as instruments, laboratory equipment and supplies are demonstrated in finished form and in working models and animations. A large part of the exposition will be given over to production equipment, exhibited for the most part in complete units, ready for installation in plants, but frequently demonstrated by cutaway models, transparent sections revealing material in simulated processing or by flow charts and action displays. Taken as a whole there is scarcely a single processing step or treatment used by the chemical processing industries that is not represented by at least one exhibit at the exposition.

Biblical Conservation

The Cooperative Forest Fire Prevention Campaign recently published a booklet with the title, "The Forest and Flame in the Bible." The booklet says "There are many passages

They are probably all tempting to you, and they all have one thing in common — they all have been wrapped by *heat seal methods.*

The economies and advantages of heat seal methods are well known. ARCCO offers paper, film and foil converters, a commercially proven line of specialty heat seal coatings and adhesives. They are available in emulsion, solution, and hot melt types and can generally be applied with your present equipment.

They can be engineered to possess various characteristics to suit your particular requirements. An ARCCO engineer will be happy to work with you. Write for data sheets.

ARCCO 1044-29A — Universal Heat Seal Coatings for Glassine, Paper, Aluminum Foil and Cellulose Acetate. Data Sheet C-66.

ARCCO 1044-31 — Heat Seal Coating for Candy Bar Wraps. Data Sheet C-66.

ARCCO 716-6 — Heat Seal Spot Coating for Waxed Glassine. Data Sheet C-66.

FOILAC 1261-12C — (Clear) Solution Coatings for Metal Foils. Data Sheet C-61-R.

ARCCO 1044-27A — **ARCCO 1044-27B** — Heat Seal Greaseproof Resin Emulsion Coatings. Data Sheet A-43.

ARWAX 717-46B — Hot Melt — paraffin wax additive for improved heat seal and improved water-vapor resistance. Data Sheet C-71.

ARCC

AMERICAN RESINOUS CHEMICALS CORPORATION

RESIN EMULSIONS, SOLUTIONS AND HOT MELTS FOR ADHESIVE BASES, BINDERS, COATINGS, SIZES AND SATURANTS

GENERAL OFFICES: 103 Foster Street, Peabody, Massachusetts

in the Bible that tell how our forests serve us and how we should protect them . . . the Bible urges us to the protection and wise use of our forest, range, and woodlands . . . ." *Forests Echoes* (Crossett Paper Co.) reprints here part of the booklet believing that it will be of interest to all Bible students:

Man Finds the Forest a Place of Beauty and a Sanctuary

"The glory of Lebanon shall come unto thee, the fir tree, the pine tree, and the box together, to beautify the place of my sanctuary; and I will make the place of my feet glorious." ISAIAH 60:13.

"The voice of the Lord . . . discovereth the forests; and in his temple doth every one speak of his glory." PSALM 29:9.

So Protect the Bounty of the Earth for Nature Is the Work of God

"He hath laid my vine waste, and barked my fig tree: he hath made it clean bare, and cast it away; the branches thereof are made white." JOEL 1:7.

"And it was commanded them that they should not hurt the grass of the earth, neither any green thing neither any tree; . . ." REVELATION 9:4.

And Keep Fire from the Trees, However Small the Flame

" . . . Behold, how great a matter a little fire kindleth!" JAMES 3:5.

"As the fire burneth a wood, and as the flame setteth the mountains on fire." PSALMS 83:14.

For Fire Can Destroy All That Grows

"A fire devoureth before them; and behind them a flame burneth; . . . behind them a desolate wilderness; yea, and nothing shall escape them." JOEL 2:3.

It Can Plague Forest and Field; Man and Animal

"How do the beasts groad. the herds of cattle are perplexed, because they have no pasture; yea, the flocks of sheep are made desolate. O Lord, to Thee will I cry; for the fire hath devoured the pastures of the wilderness, and the flame hath burned all the trees of the field." JOEL 1:18–19.

It Can Dry Up the River

The beasts of the field cry also unto thee: for the rivers of water are dried up, and the fire hath devoured the pastures of the wilderness." JOEL 1:20.

It Can Lay Bare the Field

"Therefore as the fire devoureth the stubble, and the flame consumeth the chaff, so their roots shall be as rottenness, and their blossoms shall go up as dust." ISAIAH 5:24.

And Man Realizing His Loss, Must Set Out to Clothe the Land with Trees

"Thus saith the Lord God; I will also take of the highest branch of the high cedar, and will set it; I will crop off from the top of his young twigs a tender one, and will plant it upon a high mountain and eminent." EZEKIEL 17:22.

"And when ye shall come into the land, and shall have planted all manner of trees for food, then ye shall count the fruit thereof . . . ." LEVITICUS 19:23.

"And Abraham planted a grove in Beersheba, and called there on the name of the Lord . . . ." GENESIS 21:33.

And If a Tree Is Cut or Burned, Grow Others in Its Stead

"He heweth him down cedars, and taketh the cypress and the oak, which he strengtheneth for himself among the trees of the forest: he planteth an ash, and the rain doth nourish it." ISAIAH 44:14.

"For there is hope of a tree, if it be cut down, that it will sprout again, and that the tender branch thereof will not cease." JOB 14:7.

PAPERMAKING AS A CAREER

There are many good reasons why every high school senior with ambitions to become an industrial leader should consider pulp and paper manufacture as a career. Among the advantages of selecting this industry as the field of your choice may be cited the following:

1. *It is a large industry* operating more than 1000 mills and employing upward of 1,000,000 people in such a diversity of occupations that one may change his employer, his location, or even the nature of his work with relative ease.

2. *It is a stable industry* free from the violent fluctuations in activity and employment which characterize many of our national enterprises. In the great business depression of the thirties when general manufacturing employment declined 36%, the paper industry was able to hold its decline to 21%.

3. *It is a growing industry*, the production of paper increasing from 17.8 million tons in 1941 to 26 million tons in 1951, an expansion of 46%. In the last 50 years the production of paper in the United States has multiplied tenfold, while the giant steel industry has increased only six times, population has simply doubled, and the production of cotton has actually declined. Today there are more than one hundred thousand different uses for paper and new products are being constantly developed. Experts predict that the production of paper will at least again double within the next 25 years.

4. *It is a prosperous industry* paying top wages and salaries to its employees and being noted for its freedom from prolonged strikes and otherwise having one of the best records of harmonious management and labor relations of any major American industry. A survey conducted by a Northern forestry school which trains men for the paper field discovered that its paper graduates, after 10 years' experience, earned approximately $1000 more, annually, than the graduates of other departments.

5. *It is a fascinating industry* which intrigues its workers with a multitude of problems, intricate processes, huge machines, and a diversity of useful and beautiful products unequaled by any other manufacturing enterprise. The Northern school which conducted the salary survey found that 90% of all of its pulp and paper graduates were still employed in the field for which they were trained in contrast to only 60% of the graduates of its several other divisions. Undoubtedly these percentages would hold true generally for most other institutions training men for this field.

6. *It is a southern industry* having been established here as early as 1744 and being forced to expand continuously by the migration of mills from the North that moved here to locate near adequate wood supplies which are so essential to the life of this industry. In 1951 over 50% of the pulpwood and nearly 50% of the domestic production of pulp and paper were manufactured in the 12 states south of the Mason-Dixon line, making the South the largest regional producer of pulp and paper products in the United States. The proximity of many large paper mills assures the young technical graduate of ample employment opportunities within a reasonable distance of his boyhood home and in a location with a climate to which he is accustomed.

7. *It is an industry that recommends specialized training for its future employees* and gives such men preference in employment and choice of positions. The approved type of professional training is embodied in the four-year undergraduate curriculum in pulp and paper technology recently established at the North Carolina State College of Agriculture and Engineering. The School of Forestry is housed in a new $850,000 modern building and in addition the College is now building and equipping a $200,000 pilot plant laboratory for instruction in all phases of pulp and paper manufacture under the direction of a competent staff with many years of experience in this field of education.

Packaging

Almost 14 million tons of paper and paperboard are consumed annually in all types of packaging, L. W. Elder of General Foods Corp., told the Division of Agricultural and Food Chemistry at the 124th National A.C.S. meeting in Chicago recently. One third of this tonnage is used by food packers. It is impressive to note, he added, that more paper is used for packaging than for all printing papers, including newsprint.

Mr. Elder, in presenting the food packer's view of packaging materials, complimented the can manufacturing industry for reducing tin consumption per can by nearly 45% through the use of protective coatings. What about future prospects? A program has been launched to develop a completely tinless, solderless can. Among the new developments to be watched is the polyethylene "squeeze" bottle. Bags, envelopes, and tubes appeal to food packers for general attractiveness and economic reasons. Some of the materials used include cellophane, glassine, aluminum foil, polyethylene, pliofilm, and saran.

Although a wide variety of materials is available now and many special combinations are yet to be expected, the food packer would still welcome from the chemical industry the perfect packaging film. This "ideal" product would have the following properties: high resistance to puncture and tear; enough stiffness to feed well through high speed equipment; good printing surface; transparency in the visible range combined with opacity in the ultraviolet region; impermeability to water vapor, oxygen, fats, and oils, and all odors; a wide melting range to permit formation of strong hermetic seals by simple heating bars or rolls; freedom from toxic or odorous plasticizers; and a cost comparable to that of wax paper. (The opportunities here should be challenging to any chemist.)

Cellophane

The use of cellophane was discussed by Nelson Allen of Du Pont. Food packaging takes about 75% of the current annual cellophane production (300 million pounds), he stated. At an average price of 57 cents per pound, this is a $170 million business. The major food industries consuming cellophane include baked goods, meats, produce, crackers and biscuits, candy, potato chips, cereals, frozen foods, and dairy products. At present the most rapidly growing fields for cellophane are meat and produce. In 1945, 15 stores had 100% self service of these items; today the number is nearly 6000. Over one third of all the cellophane produced is sold to converters who print the film, fabricate it into bags, cartons, envelopes, and other items. These are then sold to the ultimate users.

Pliofilm

For several years after its introduction during the depression year of 1933, primary commercial uses of pliofilm were in the fabrication of raincoats, capes, and other specialty items, reported P. J. Vaughan of Goodyear Tire & Rubber Co. In recent years, development efforts have been concentrated on the adaptation of standard packaging equipment to the use of low gage pliofilm at the high speeds necessary for modern food packaging lines. Illustrating the tolerances that are dealt with in the industry, the maximum thickness (250 gage) is still somewhat less than the diameter of a human hair. As far as the industry is concerned, they feel that the swing is toward lighter gages of film which still do the packaging adequately. Films stretched to extreme thinness, such as 0.00020 in., open entirely new fields to packaging which have not been previously approached because of the cost of the films. An example of this is the "stretch wrap" machine which has been developed for wrapping lettuce in stretched pliofilm. Only 65 lb. of film are required to individually wrap a carload of lettuce.

Metal and Composite Cans

Too often the total package cost is confused with the cost of the container itself. According to Roger Wilson, of Continental Can Co., the total packaging cost includes not only the cost of the container, but that of receiving, conveying, filling, and closing it. This cost is affected by the speed with which the package may be handled, the breakage and spillage which may result from its use, the outer shipping containers which it requires, and the total shipping cost to its destination.

Interlingua

The root language of the western world, Interlingua, is being introduced into scientific and technical publications as a workable and economical solution to the problems of international communication.

The preceding paragraph, translated into Interlingua, reads as follows:

Le lingua radice del mundo del west, Interlingua, va intrcducente se in periodicos scientific e medical como un methodo practic e economic de solver le problema de provider summarios de articulos que pote esser legite per specialistas in qualcunque parte del mundo.

Science Service has received a 1-yr. grant from the International Auxiliary Language Association to handle introduction, translation, and teaching of this "common denominator" language to science and technology editors and other interested persons.

Based on the principal western languages, Interlingua with its simplified uninflected grammar and universal vocabulary is read virtually without study by anyone who normally reads scientific and medical journals. A grammar and Interlingua-English dictionary has been published under the editorship of Mr. Alexander Gode of Science Service.

Already the first scientific journal in Interlingua, *Scientia International*, published by Science Service, is about to enter its second year. *Spectroscopia Molecular*, a monthly journal on spectroscopy, is published exclusively in Interlingua under the editorship of Prof. Forrest F. Cleveland, Illinois Institute of Technology, Chicago 16, Ill.

One of the most important aids of Interlingua to science editors will be the use of a single Interlingua summary in place of several summaries in different languages for each of the scientific papers. Thus Interlingua will give both practical and economical advantages over older methods of abstracting.

The Interlingua Div. of Science Service located at 80 E. 11th St., New York 3, N. Y., offers translation service to medical and other journals in preparing Interlingua versions of summaries, abstracts, papers, etc., for publication.

Further details concerning Interlingua can be obtained from Mr. Alexander Gode at the New York office, or from Watson Davis, Director, Science Service, 1719 N St., N. W., Washington 6, D. C.

SKF

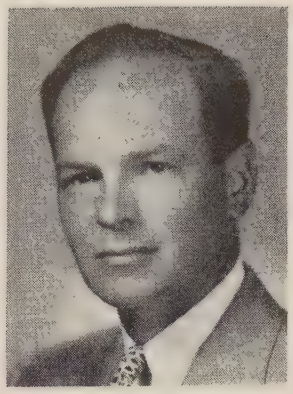
SKF Industries, Inc., Philadelphia 32, Pa., has published a 12-page bulletin describing a new line of improved spherical roller bearings. It is claimed that these "C" type bearings will give 2 to $3^1/_2$ times the service life, with 25 to 50% greater capacity than formerly possible.

Pioneer Latex

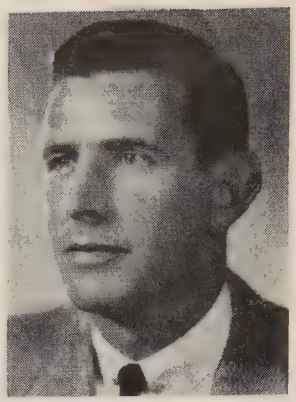
Pioneer Latex and Chemical Co., Lincoln Blvd., Middlesex, N. J., announces a new combining adhesive, G-602, which allows very thin films of vinyl to be laminated to cloth and paper.

Continental Can

R. A. Reinke has been appointed technical coordinator of Continental Can Co. at 1400 W. 10th Ave., Amarillo, Tex.



G. A. Sharpe, General Dyestuff Corp.



B. F. Leaman, Jr., Owens-Corning Fiberglas Corp.

OWENS-CORNING

Owens-Corning Fiberglas Corp., Toledo 1, Ohio, has organized a new Sound Control Products Sales Div., with Ben F. Leaman as manager. A brochure describing Kaylo heat insulation has been issued by Owens-Corning.

Also announced is a new finer-fibered, preformed Owens-Corning pipe insulation.

GENERAL DYESTUFF

Grant A. Sharpe has been appointed sales representative of General Dyestuff Corp. in upper New York State.

WITCO

Witco Chemical Co., 260 Madison Ave., New York, N. Y., has published a Technical Service Report (p. 18) describing Witcarb V and P, precipitated calcium carbonates.

MINNEAPOLIS-HONEYWELL

Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa., has issued a data sheet (I.D.S. No. 29-0-4) describing instrumentation required for a typical thermal converter type consistency control system used in the paper industry.

LODDING

Lodding Engineering Corp., Worcester, Mass., has expanded its research and development program, under the direction of F. H. Goyette, chief engineer. Harold E. Dunlap has been promoted to the position of chief draftsman, John V. Delaney becomes sales engineer, and H. C. Burdett has been designated project engineer.

BAKELITE

James F. Eversole has been appointed vice-president in charge of research of the Bakelite Co., a division of Union Carbide & Carbon Corp.

PERKINS-GOODWIN

Perkins-Goodwin Co. has opened a sales office at Room 1101, Parks Sq. Bldg., 31 St. James Ave., Boston, Mass.

FISCHER SCIENTIFIC

A 60-page gas analysis manual has been issued by the Fischer Scientific Co., 635 Greenwich St., New York 14, N. Y.

G.E.

General Electric Co., Schenectady 5, N. Y., has published a 12-page bulletin (GEA-5408A) on d.c. crane-drive equipment.

JOHNSON

Johnson Corp., Three Rivers, Mich., announces a new self-supporting joint, designated as Series 2000 Type S, for admitting steam or other fluids to rotating rolls.

B. & W.

Babcock and Wilcox Co., Beaver Falls, Pa., has issued a 6-page folder (IDC 163) containing technical data on 14 tubing steels used in high temperature or high pressure service.

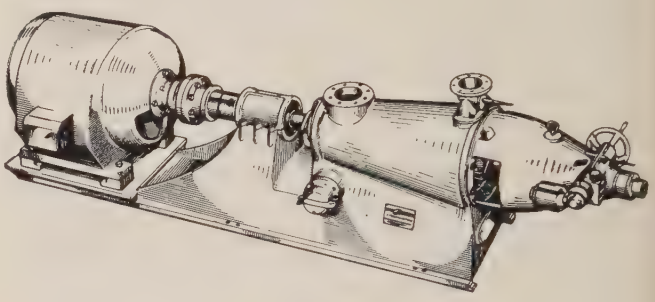
HUBER

The Ink Division of the J. M. Huber Corp., formerly located in Brooklyn, N. Y., has moved to 1478 Chestnut Ave., Hillside, N. J.

J. M. Huber Corp., 100 Park Ave., New York, N. Y., has published an article on the research and development program of Champion Paper and Fibre Co. in the August issue of *Huber News*.

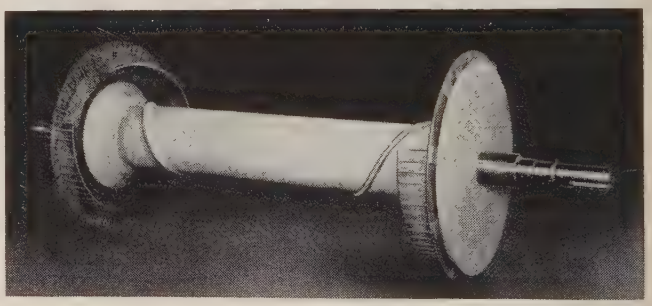
E. D. JONES

E. D. Jones & Sons Co., Pittsfield, Mass., announce the development of a new Mark II Rotor for their line of Pulp-



The Jones Stockmaster

Masters. Also announced is the Jones Stockmaster, a new conical refiner, and the Jones Laboratory Beating Unit.



The Mark II rotor for the Jones Pulp-Master

A new edition of the Jones firm's booklet "A Study of the Beater" has just been issued.

ALBANY FELT

Albany Felt Co., Albany, N. Y., announces that its new mechanical and physical research laboratory is to be ready for use this Fall. Albany has recently recruited several men for its training program in preparation for sales.

PHILADELPHIA QUARTZ

Philadelphia Quartz Co., Public Ledger Bldg., Philadelphia 6, Pa., announces a patented adhesive process known as the STIXSO 3-Way Process, which may be used without royalty by permission of the company.

FOXBORO

Foxboro Co., Foxboro, Mass., has issued a 16-page bulletin

W. H. Lee, Chairman of the Board, Lockport Felt Co.

R. J. Lee, President and Treasurer, Lockport Felt Co.

(467) describing dial thermometers for long-distance measurement and control.

LOCKPORT

Lockport Felt Co., Newfane, N. Y., announces completion of plans for a new plant at Starkville, Miss.

CHROMALOX

Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8, Pa., has issued application reports on the use of Chromalox far-infrared radiant heaters in the printing industry.

DOW-CORNING

Dow-Corning Corp., Midland, Mich., has issued its 1953–54 Reference Guide to Dow-Corning silicone products.

HERCULES FILTER

Hercules Filter Corp., 204–208 21st Ave., Paterson 3, N. J., has published two leaflets describing the Hercules Pressure Leaf Filter and the Hercules Self-Cleaning Pressure Leaf Filter, and the November issue of *Hercules Filtration Fact Finder* carries an article on "Why and How Paper Mills Use Hercules Filters."

DOW

Dow Chemical Co., Midland, Mich., has established a new employee classification, *research specialist*, for the purpose of giving recognition to research ability equal to that afforded by administrative classifications.

A Plastics Production Laboratory has been established at the Midland Div. of the Dow Co. The new laboratory is under the supervision of W. H. Schuette, manager of plastics production. J. Lawrence Amos is laboratory director and A. F. Roche is assistant director.

RELIANCE

L. E. Blackwell, Jr. has been appointed sales application engineer with Reliance Electric and Engineering Co. in its sales office at 1208 Liberty Life Bldg., Charlotte, N. C.

CHEMICAL LININGS

Francis E. Penney has been appointed supervising engineer for field construction operations of the Chemical Linings, Inc., Watertown, N. Y.

DIAMOND ALKALI

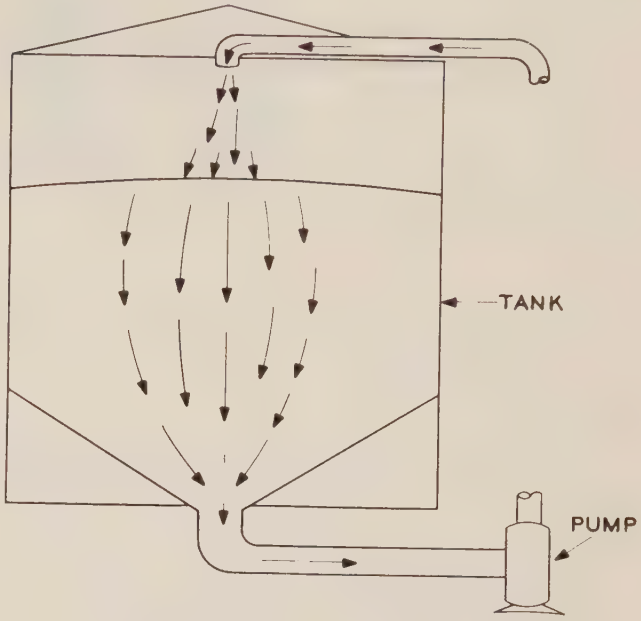
Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 4, Ohio, announces the promotion to the rank of vice-president of W. H. McConnell, director of sales, and C. E. Lyon, Houston electrochemical plant works manager. Two new divisions of this company are also announced: the Plastics and Agricultural Chemicals Div., with A. L. Geisinger, a vice-president, as general manager; and the Chromium Chemicals Div., with Frank W. Jarvis as general manager.

ARIES

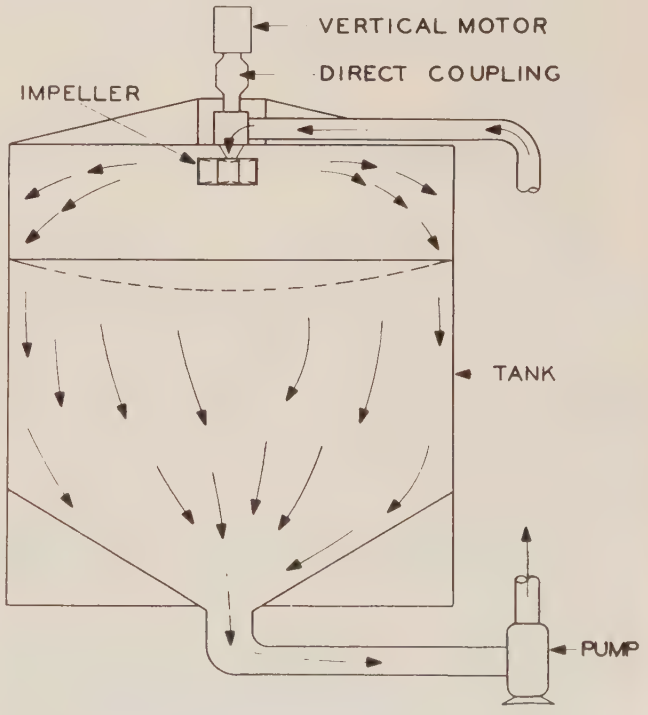
R. S. Aries & Associates have moved their executive offices to 270 Park Ave., New York, N. Y.

A.-C.

Allis-Chalmers Mfg. Co., 828 S. 70th St., Milwaukee, Wis., has issued a leaflet (28 x 7969) on effective water sampling.



Paper stock flow without "Side-Flo" unit



Stock flow with the "Side-Flo" unit

A new A.-C. development, the Side-Flo unit, helps to prevent stock from sticking or hanging to the sides of stock chests.

Du Pont

Kirkpatrick P. Ferguson has been appointed manager of the Lakes, Paper, and Leather Section of the Dyes and Chemicals Div. of E. I. du Pont de Nemours Co., Wilmington, Del.

Ingersoll-Rand

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y., has published an 18-page bulletin on class CNTA multistage centrifugal pumps.

Hanchett

Hanchett Mfg. Co., Big Rapids, Mich., has issued its new catalog of equipment and information for the saw and knife fitter.

S. A.

Stephens-Adamson Mfg. Co., Aurora, Ill., has published two bulletins, No. 753 on SA car-pullers, and No. 853 on SA hand and motor winches.

B-I-F

Builders Iron Foundry, 345 Harris Ave., Providence 1, R. I., has changed its name, and will in the future be known as B-I-F Industries, Inc.

Waldron

John Waldron Corp., New Brunswick, N. J., has published a bulletin (1012) describing Waldron rewinding equipment.

Lukens

Lukens Steel Co., Coatesville, Pa., is now making a special steel for sulphate digesters.

Consolidated Chemical

Consolidated Chemical Industries, Inc., 630 5th Ave., New York, N. Y., to celebrate their 75th anniversary, have published a 104-page catalog and historical bulletin.

Chemical Rubber

Chemical Rubber Co., Cleveland, Ohio, announces an automatic laboratory dishwasher, to be manufactured by Westinghouse at Mansfield, Ohio.

Torrington

The Torrington Co., Torrington, Conn., announces the appointment of Walter C. Thomson as executive vice-president. Ray B. Nichols, who succeeds Mr. Thomson as vice-president in charge of sales, also continues as president of the Indiana company. Rodney T. Dunlap has been named vice-president and general manager of the Torrington Co. of Indiana, with John A. Toth as assistant general manager and Walter Fisher as chief engineer.

General Aniline

Matthew M. Gouger has been elected vice-president and director of personnel relations of General Aniline & Film Corp., 230 Park Ave., New York, N. Y.

Westinghouse

Westinghouse Electric Corp., 401 Liberty Ave., Pittsburgh, Pa., has reorganized its Northeastern Region to include five sales districts, with appointments as follows: E. C. Delano, Boston district manager; E. G. Horton, Connecticut Valley district manager; W. C. Wood, Newark district manager; H. E. Dralle, New York City district manager; C. S. Purnell, regional electric utility manager; K. L. Horgan, regional industrial manager; J. C. Frink, regional transportation, marine, and aviation manager; F. G. Graf, regional agency and construction manager; H. R. Benson, regional maintenance manager; M. L. Gardner, regional engineering and service manager; E. W. Seary, regional application and training manager; R. L. Sutton, regional market planning supervisor; J. H. Rothermel, assistant to the Northeastern regional manager; R. L. Knox, manager of order services and stock control.

The Westinghouse Electric Corp.'s 57-acre Sunnyvale, Calif., plant, the largest electrical manufacturing facility in the West, will operate in the future as a single unit under the managership of George F. Gayer. It will be known as the Pacific Coast Manufacturing Plant.

Industrial Hygiene at Westinghouse

Last year, less than one man-hour was lost due to industrial ailments for every 100,000 man-hours worked by employees of the Westinghouse Electric Corp. The credit for this must go to the industrial hygiene engineers and physicians, the men and women who work constantly to eliminate health hazards. In these days of increased defense effort, almost every plant in America has found it advisable to employ a staff of these trained experts whose job it is to eliminate occupational sicknesses which may inflict reduced efficiency, lost man-hours, and drops in defense production. Their main function is to do away with any possible cause of employee illness. However, this job of eliminating the offending substance before it has a chance to do any damage is not an easy one since it may be invisible to the naked eye, or may take effect only on certain employees with an undiscovered allergy. Consequently, many methods of attack must be used, one of the most effective of which is the card-filing system.

The industrial hygiene operations staff at Westinghouse, which consists chiefly of laboratory technicians, chemists, engineers, and radioactivity specialists, maintains a card index of all the thousands of materials used by the company in manufacturing processes and personnel equipment. These indexed materials, which now number over 7000, are carefully scrutinized for evidence of toxic qualities or other properties which may be harmful to the workman. Everything from goggles and protective clothing to paint thinners, solvents, and types of steel is carefully cataloged after being checked by either the industrial hygiene laboratory or the company's material engineers. For example, if a new solvent is introduced, the material is analyzed in the laboratory for its potential toxic quality and, if it is shown to be irritating under certain conditions, that information is recorded and transmitted to all shop supervisors.

The hygiene laboratory studies all toxic processing materials, including soaps, hand creams, eye protection, etc. Some hand creams and soaps have been found to be irritating and some others have been found not to do a satisfactory job of cleaning the skin. By means of meters, chemical analyses, and plain scrubbing of dirty hands, the laboratory technicians have determined the percentage of scouring materials in the various soaps, their alkalinity, lathering qualities, water softening ability, and the presence of irritating substances. It was found that soaps differ widely, especially in amounts of scouring material; some contain as much as 45%, others as little as 5%. By selecting the proper soap, hygienists have substantially reduced skin irritations.

A principal threat to health strange as it may seem is the air, and hygienists constantly check it for harmful dusts. For this job, they use an electrostatic dust and fume sampler. This fume sampler sucks air into a small metal tube, electrically charges the dust particles, and hurls them to the walls of a grounded cylinder. The sample is then analyzed in the laboratory by the hygiene engineer. He magnifies the tiny dust particles to 1000 times their actual size and projects them on a special screen for observation. If the dust concentration in the air is above a specified level, he recommends that special protective devices be installed. A ventilating hood is

placed over the machine or the workman is required to wear a respirator if added ventilation is not practical.

A painstaking and thorough check of dust is made at each Westinghouse plant at set time intervals. Usually, dust is checked for three factors: composition, number of particles per cubic foot of air, and size of particles. At the same time, an evaluation is made of the dust or fumes around the worker's immediate area. Many other analyses of the air are made; for instance, for the presence of carbon monoxide around gas-fired furnaces.

A good deal of the success of the industrial hygiene operations staff depends upon its engineering knowledge. It must be able to discover possible hazards. An example of the use of this engineering knowledge is found in the unloading process used for powdery flint, feldspar, and clay. To avoid difficulty with these powdery materials, a pneumatic conveyor which sucks up six to eight tons of material in an hour was devised. The powder is stored in huge silos and, as a result, workmen are not exposed to excessive dust in the air.

To aid them in increasing their engineering knowledge and in reducing the number of accident hazards to the lowest possible minimum, Westinghouse hygiene engineers conduct numerous tests. Knowing that slips and falls account for approximately 25% of all industrial accidents, they devised their own mechanism for testing the slipperiness of floor waxes. The device has a hinged leg which extends to the floor and a leather or felt boot at the end of the leg which measures 2 sq. in. in area—the approximate size of the heel of a woman's shoe. A downward pressure of only 20 lb. is needed to simulate the weight of a person. The end of the leg is moved outward along the waxed surface to a point where it will slip or give way completely. By measuring the distance the boot traveled before slipping, the testers are able to tell how easily a person may slide on the wax.

With more and more plants making use of machines that utilize atomic energy, hygienists must continually enlarge their scope of operations where radiation is concerned. Using knowledge gained from a study of the effects of atomic radiation and methods of measuring radiation intensity at the atomic plant at Oak Ridge, hygiene engineers maintain a constant check for preventing physical harm resulting from the use of radioactive isotopes and x-ray machines employed at the various Westinghouse locations. Special steps are taken to make certain that employees do not breathe radioactive dust or fumes and that the skin or other parts of the body are not affected by radiation from radioactive sources.

OBITUARIES

Harry C. Bradford

Harry C. Bradford, vice-president and secretary of the Rex Paper Co., Kalamazoo, Mich., died at his home in Kalamazoo on Sept. 6, 1953.

Mr. Bradford was born in Crystal Springs, Kan., on Aug. 16, 1881. He was a high school graduate and self-educated in the field of chemistry.

From 1908 until 1916 he was mill chemist for the Lee Paper Co., Vicksburg, Mich. From 1916 to 1922 he was chemist for the King Paper Co. Div. of the Allied Paper Mills in Kalamazoo. He joined the Rex Paper Co. in 1922 as a chemist and purchasing agent.

Mr. Bradford was active in civic affairs in Kalamazoo and was the third chairman of the Kalamazoo Valley Section of the Technical Association of the Pulp and Paper Industry.

Stephen B. Stafford

Stephen B. Stafford

Stephen B. Stafford, 72, secretary of Rice Barton Corp., Worcester, Mass., died on Sept. 8, 1953, at Worcester.

He started work with Rice Barton Corp. in 1897 as an apprentice. Mr. Stafford served in all departments, serving as chief engineer, sales engineer, and at the time of his death was secretary of the Corporation and a director. He was well known in both the paper industry and textile industry.

He is survived by Mrs. Helen R. Stafford and two sons, Stephen Philip Stafford of Newport News, Va. and Donald B. Stafford, who is a sales engineer for Rice Barton Corp.

Norman Cecil Fairhead

Norman C. Fairhead, control superintendent of the St. Lawrence Pulp & Paper Co., Ltd., Red Rock, Ont., died on June 1, 1953, at the Port Arthur General Hospital, Port Arthur, Ont., of monocytic leukemia.

Mr. Fairhead was born in Edmonton, Alberta, on Feb. 22, 1923. He graduated in chemical engineering in 1949 from the University of British Columbia. During World War II he served with the Royal Canadian Air Force.

He is survived by his wife, Murie, his parents, Mr. and Mrs. Cecil Fairhead, and his sister Margaret. He was a member of the Technical Association of the Pulp and Paper Industry.

RECENT BOOKS

Organic Analysis. Vol. I. Edited by John Mitchell, Jr., I. M. Kolthoff, E. S. Proskauer and A. Weissberger. Interscience Publishers, New York, 1953. Cloth, 6 × 9, 473 pages. $8.50.

Quantitative analysis as taught in universities deals largely with inorganic systems or with the elemental analysis of organic compounds. The student learns the theoretical and practical fundamentals of quantitative analysis with emphasis on gravimetric and volumetric procedure. The student does not become acquainted with the field of organic quantitative nonelemental analysis in spite of its great importance to industrial organic and analytical chemists.

The series "Organic Analysis" is designed to fill this gap in the education of analytical and organic chemists, to consolidate current knowledge, and to evaluate critically the many procedures employed.

Included in the text are chapters on hydroxyl groups, alkoxyl groups, active hydrogens, carbonyl compounds, acetals, organic sulphur groups.

Note: Books mentioned in this column may be obtained from the Book Department of the Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

LOCAL SECTION ACTIVITIES

Reports of Meetings, Personnel, and Events

Empire State (Metropolitan District)

The first dinner meeting of the season of the Metropolitan District, Empire State Section of TAPPI, was held at 6:30 p.m. on Tuesday, Sept. 22, 1953, at Fraunces Tavern in New York City. About 85 members and guests were present.

Presiding was Chairman Ralph Kumler, who introduced those at the head table and told of the aims of the district for the future. Plans are under way to issue a monthly newsletter for the district, edited by Dudley Nixon of Geigy Co. All members were asked to send items of interest to Mr. Nixon. The program chairman, Lew Ayers, announced that at the next meeting on Oct. 20, 1953, Henry Perry, executive secretary of the Wastepaper Utilization Council, will lead a discussion on "Problems in Wastepaper Utilization."

Mr. Ayers introduced the three members of the panel for the evening: Gardiner Lane, assistant to the executive vice-president; K. A. Arnold, technical director, and G. T. Joyce, development engineer, all of the St. Regis Paper Co. The panel discussed "Product Development in Industrial Packaging."

Mr. Lane, who acted as moderator, discussed the over-all cooperation between departments when developing a new package. He said that before any extensive work is done on a new project, it must meet the approval of the following departments: (1) market research (appraises potential), (2) technical research (develops package), (3) patents (investigates possible infringements), (4) purchasing (investigates availability of necessary materials for both package and filling machinery), (5) manufacturing (appraises manufacturing problems), (6) comptroller (checks on capital expenditures required), (7) engineering (develops new equipment for package manufacture as well as packaging machinery and educates consumers in its use), (8) traffic (tries to obtain freight classification approval), (9) advertising (sales promotion), and (10) sales (direct customer approach). All departments are kept completely informed as the work progresses, and they may eliminate a project at any stage of its development.

Mr. Lane went on to give some examples of new packaging methods developed by St. Regis. When the Monsanto Chemical Co. asked for a new, cheaper package to replace fiber drums for packing polystyrene, all departments cooperated to produce a multiwall bag with a polystyrene coated inner lining. Although the new package seemed admirably suited for polystyrene, and Monsanto was satisfied, the ultimate user of the polystyrene did not like this new package. The polystyrene molders felt they were not set up to handle bags, and they were afraid of bags breaking. The St. Regis Paper Co. had to carry out a sales promotion campaign to convince the polystyrene users that the multiwall bag would benefit them.

Another problem that was successfully solved was the development of a paper bag to replace the cloth flour bag. Here again, after developing a satisfactory new package, they had to convince the consumer of the economical and sanitary advantages of using paper bags. These are good examples of cooperation between the producer and user of the package and the ultimate consumer of the contents.

Today the St. Regis Paper Co. is working on a semirigid bag to replace cartons used for packing unit packages. Although this bag shows a number of advantages, its suitability and usefulness to the consumer must be demonstrated.

Mr. Lane introduced K. A. Arnold to speak on the role of the technical department in product development. Mr. Arnold listed the following four important jobs of the technical department: (1) analysis of customer problems, (2) research on new problems, (3) pilot plant operation, and (4) plant quality control and issuance of specifications on products.

In discussing their test procedures, Mr. Arnold stated that they have found little correlation between laboratory tests and actual package performance. For this reason they have established a special laboratory in Florida to test, under the most adverse conditions, actual packages containing the material they are to hold.

Following up the examples given previously, Mr. Arnold told of the technical problems encountered in developing the multiwall bag for polystyrene, and the paper bag to replace the cloth flour bag.

After a suitable package is designed, the engineering department develops the machinery and equipment to handle it. Mr. Arnold introduced Mr. Joyce to discuss this phase.

Mr. Joyce explained that St. Regis was almost forced into the development of packing machines stating that frequently, unless you can give your customer equipment to handle a new product, it will be a failure in the field.

When the valve bag was first developed only four types of packing machines to go with them were needed. Today there are 42 types of packing and filling machines to handle valve bags. This large number is necessary because each customer's packing operation presents a specific problem, and almost all the packing machines made today are individually tailored to suit the customer's particular product. After any new package is developed, the engineering department may be called on to design the packing equipment. Such equipment is first tried out in the customer's plant on a temporary setup. After all the problems of operation are solved, it is put into a permanent location. To make sure that the machines are operated and serviced properly, St. Regis has a group of sales engineers and such an organization is necessary because the equipment must be in good operating order for the customer to get optimum results.

The talks were followed by an interesting discussion period.

L. E. Georgevits, *Publicity Chairman*

Empire State (Northern District)

The October 8 meeting of the Northern District was held at La Martina's Restaurant in Watertown, N. Y. A summary of the talk given by the speaker, K. A. Arnold, technical director of the St. Regis Paper Co., follows:

European Paper Developments

K. A. Arnold

In the field of pulping, European mills are quite active in development of new processes and new raw materials to reduce cost of pulp. Due to shortage of timber on the Continent and in Great Britain, the majority of wood pulp is imported from Scandinavian countries. An interesting opera-

K. A. Arnold, Technical Director, St. Regis Paper Co., Deferiet, N. Y.

J. H. Treadwell, Treadwell Supply Co.; R. J. Murtaugh, K. A. Arnold, and J. D. Parmele, St. Regis Paper Co., S. J. Young, National Paper Products Co., and D. C. Mather, Carthage Paper Makers, Inc.

tion at Nanterre, France, is the continuous pulping of straw, using a soda liquor. The straw was cut, dusted, impregnated with soda liquor and introduced into the pulping tower. This tower has an average capacity of about 30 tons pulp per day. A continuous, three-stage bleachery is capable of producing brightness in 70 to 80 range. The fully bleached straw pulp is very slow in drainage on the paper machine. This limits its usage to 40% of the furnish. It is used in certain printing paper grades where it contributes to the levelness and finish of these papers. The Nanterre pulp plant is an efficient operation. Current fluctuations in prices of straw and chemicals are understood to make this pulp relatively expensive at certain periods.

In England, there has been considerable development of high-yield processes applied to hardwoods. Definite improvements in hardboard production have been reported.

At Mannheim, Germany, a small pilot plant to produce semichemical sulphite pulp from beech has been operated for some time. Although this pulping with very weak calcium-base sulphite liquor requires up to 18 hr., a high yield of strong pulp is obtained. The pulp is readily bleached. It can be used for glassine, writing paper, or can be further purified for certain dissolving grades. This pulp is low in cost and high in strength. A further advantage of this process is very low degree of pollution of streams or rivers by the pulp mill effluent.

In Sweden, both sulphite and kraft pulp mills were observed. In some cases, wood is selected so that with a lighter color goes to the sulphite operations and the darker color wood to kraft. The kraft may be cooked on a 6-hr. cycle, using external circulation and heating of the cooking liquor. Both the Morterud and Shaffelburger circulating systems were observed in operation here.

One mill uses up to 25% chips from their saw mill in wood for the kraft plant. Above this percentage, they observe some decrease in strength. On kraft they use a five-stage bleachery to achieve 85 brightness in pulp. The fifth stage is chlorine dioxide. About 1% ClO_2 is consumed in this stage. Because of advantages in pulp strength and brightness, they will soon use ClO_2 in the last stage of their sulphite bleachery.

M. Peterson & Sons, Moss, Norway, is pulping softwood by the Asplund continuous semichemical high yield process. The kraft cooking liquor for this pulp is derived from their adjacent kraft pulp mill. Thus, the spent liquor can be returned for recovery. The pulp thus produced is for board grades. This process is one of the most efficient and trouble-free operations of its type observed anywhere.

PAPERMAKING

Throughout Europe, most of the older machines running on kraft or sulphite average about 600 f.p.m. In kraft paper mills, except in Scandinavia, at least 20% of the furnish is usually wastepaper.

The new machines generally operate between 850 and 1300 f.p.m., depending on the grade being run. Natronag at Oker, Germany, recently started up a new fourdrinier. This machine has a pickup felt, Yankee drier, and one after-drier drum and was designed for machine glazed asphalting and grocery bag kraft grades. Its expected speed is from 850 to 950 f.p.m. An efficient new unit for cleaning and refining used bags has also been installed here. A four-roll continuous Wolff beater was observed in operation at Oker. This is somewhat similar in effect to the three-roll Victory beater at the St. Regis Jacksonville plant. This type beater appears more efficient since less of the power is wasted in circulating the water content of pulp suspensions.

Korsnas has a new 210-in. Karlstad machine in operation. This was designed primarily for their new "Microcrepe" multiwall grade and has an expected production of 160 tons per day with speeds in the range of 1000 f.p.m. This machine has seven drier sections allowing the unusual degree of speed control throughout the driers. The refining system for this machine is composed of jordans.

EXPERIMENTAL PAPER MACHINES

The new 40-in. Voith fourdrinier paper machine at the Mannheim Research Department was exhibited and described to those attending the St. Regis International Convention at Baden-Baden. The refining units and the machine were designed to handle all types of pulp and produce all types of paper. The refining system was composed of conventional repulper, Hollander beaters, and jordans. The over-all installation can be operated continuously to produce 2 tons per day of 50-lb. paper. Special equipment on the machine includes: (1) an offset sizing (or smoothing) press, (2) a Yankee drier for creping, (3) a Yankee drier for machine glazed paper, (4) a two-roll smoothing press, (5) a regular size press, and (6) cooling cylinders at end of driers. The speed range is 15 to 500 f.p.m. Space is provided for a small machine-coating arrangement ahead of the MG Yankee.

The Swedish Forest Products Research Institute at Stockholm also has a 40-in. experimental paper machine, designed for speeds up to 650 f.p.m.

PAPER AND BAG TESTING METHODS

All kraft mills visited contained the normal types of paper testing equipment. In addition, there was special equipment for analyzing the stress-strain curves on tensile-type machines. In the Buhrman laboratory, Mr. Bekk has extensive data on the dynamic tensile tester as now manufactured by A. W. Van der Korput, Baarn, Holland. Indications are that this test correlates with bag drop tests and general resistance to shock damage. This correlation has also been noted by PATRA of London, and by the Korsnas AK. laboratory in Gavle.

At Natronag, the elevator drop test has proved the best laboratory evaluation of finished bag strength. Among the corresponding paper tests this test shows the closest correlation with the product of tensile times stretch. In the Natronag laboratory, one tensile tester is equipped to draw a diagram of the tensile-stretch curve on the paper sample. It can be used also to demonstrate accurately the degree of nesting of the plies in a production bag. The bursting pressure of finished bag can be measured here, by slipping the bag over a large rubber bag. This can then be inflated by hydrostatic pressure. The pressure at the rupture of the paper bag can then be recorded.

At Korsnas, the Steenberg stress-strain analyzer, which records percentage of stretch very accurately, was used in the development of high stretch paper on the machine.

At Swedish Forest Products Research Institute excellent studies on paper testing are progressing. Mr. Steenberg has developed a rather simple tester which will measure work capacity of a paper strip when it is subjected to a breaking load

J. D. Parmele, St. Regis Paper Co. and D. C. Mather, Carthage Paper Makers Inc. with the new banner of the Northern District

applied at 1 meter per sec. This high speed tester should be available commercially in about 6 months. It should be very effective in evaluating kraft for breakage strength at high speed.

GENERAL OBSERVATIONS

The paper business in Europe was suffering from a temporary recession with the possible exception of Belgium. This condition had existed for several months in most places.

Price of creped kraft is generally 15% higher than flat kraft.

Mills in Europe, excepting new units, use from 7 to 14 beaters on a single machine and thus consume considerably more power in refining pulp than is customary in the United States.

Asphalt laminating machines were noted running at speeds from 150 up to 500 f.p.m. Bag-making concerns in Europe generally perform their own laminating with asphalt. The flat asphalt laminated kraft is generally 30 lb. natural kraft/30 lb. asphalt laminated/30 lb. natural kraft; the creped kraft is generally 43 lb. natural kraft/35 lb. asphalt laminated/43 lb. natural kraft.

Increased competition is producing a marked trend of general interest toward kraft specialty papers for uses other than multiwall sacks. Some papers discussed were wrapping, antitarnish such as steel interleaving, vapor-phase-inhibitor paper for preventing rusting of metal parts, saturating grades, rubber interleaving, gumming papers, and various types of paperboard.

European pulp and paper producers are doing considerable basic research in all phases of the industry. This research expenditure is considered excellent insurance against potential world competition for the paper market. In the United States much of the basic research is being done by chemical suppliers to the paper industry. There appears to be much greater effort, in the States, toward market development and sales promotion of paper products.

R. J. Murtaugh, *Secretary*

Empire State (Central District)

The first meeting of the Central District was held at the University Club in Syracuse, N. Y., on October 2. H. M. Gray, Oswego Falls Corp., was the chairman and during the course of the meeting appointed H. D. Cook, Sweet Bros. Paper Mfg. Co.; F. G. Sommerville, Armstrong Cork Co.; C. E. Foster, Sealright Div., Oswego Falls Corp.; and G. B. Martin, F. C. Huyck & Sons, to the executive committee which also includes the present officers: T. Foster, Foster Paper Co.; D. Geffken, Oswego Falls Corp.; A. Carlson, Burns Piping Supply Co.; and S. D. Hodge, Bloomer Bros. Co., were appointed to the attendance and membership committee.

The speaker of the evening, E. K. Mullen of the Robert Gair Co., was introduced by F. W. O'Neil of the College of Forestry. Mr. Mullen's talk follows:

Quality Requirements in Folding and Setup Boxboards

Edward K. Mullen

Gentlemen, I am a salesman—I am one of those people constantly coming back at production and telling them what our competition is doing and what the customer thinks he needs. Consequently my observations on quality requirements will reflect the pressures of a very competitive board sales field.

A production or technical man speaking on the same subject would probably approach it from the other direction and emphasize the difficulties pressed on the mill by the sales group. I assure you he could make a strong case.

With it all, effective cooperation between the two groups is absolutely necessary. Sales must recognize the inevitability of some quality failures, and production must acknowledge the constant pressure for improvement.

I am going to take a few minutes here to outline the growth which has taken place in the paperboard field—for it is this factor of growth, due to the many new uses found for paperboard, which has caused increasing demand for quality. Little more than 25 years ago—in 1925, total board production was roughly 3,200,000 tons. The year 1952 found the paperboard industry producing over 12 millions tons, with a very strong possiblity that production this year will exceed 13 million tons. Paperboard's percentage of total board and paper tonnage in 1925 was 35.8%; last year it was slightly over 50%.

The greater part of this tremendous growth has taken place in container board such as used in corrugated shipping cases and in the various board grades used by the folding carton industry.

Other categories of board production such as setup boxboards, building boards, and more particularly, special food boards have also experienced growth at varying rates.

The continuing increase in the nation's population, has, of course, been responsible for a portion of the increased demand. More important, however, has been the development of unit packaging, as opposed to bulk packaging, calling in most cases for some form of paperboard.

The folding carton industry has shared fully in this growth as to a lesser extent has the setup box industry. It is necessary only to casually glance at the shelves in a modern supermarket or drugstore to see where this huge production of boxboard grades is being consumed.

It is at this point we can recognize one of the influences which reflects itself in a demand for quality at the board mill. I have never seen statistics to verify it, but I do feel that the consumer today is presented with a much wider choice in all the consumer nondurables. There are many products we consume readily today which did not exist a few years ago, and the old staples have been modified and refined and set to many shadings of choice which were not catered to in the past.

In a word, "we are living higher on the hog." Many of these products depend on the package, a paperboard package, if you please, to do part of the selling job for them. They must not only deliver the product to the customer in first class condition, but must "ask" him to buy. The efforts of the boxmakers to produce cartons which "sell" have caused many upward revisions in board mill quality.

Edward K. Mullen, Sales Manager, Boxboard Div., Robert Gair Co., Inc., New York, N. Y.

A second influence which has manifested itself in the demand for quality is the trend toward more automatic production operations in both the setup box and folding carton fields. As in most other industries higher labor costs have caused a constant search for machines which will do the job with little or no supervision. Automatic machines generally, however, are able to tolerate quality variations over a very limited range, as compared to the more manual operations. Downtime is still very expensive and the mills are under constant pressure to supply uniform quality. Interestingly enough, one large buyer of folding boxboards said at a recent convention "let it be uniformly good or uniformly bad, not some of each, and we will get by."

A third influence on board quality and particularly noticeable in the folding grades, stems from the demands of new printing processes, new in any case to the folding carton industry. Boxboard is now printed by each of the three principal printing methods: letterpress, lithography, and gravure. Each may call for different ink vehicles or solvents requiring differing board surface characteristics.

Before proceeding into a discussion of the particular quality features with which we are confronted and endeavor to supply, I would like to pause to remind this group of one fact. A principal raw material to the manufacture of setup and folding boxboards is wastepaper. It is an economic necessity that the fiber in wastepaper be reclaimed and it is a conservation feature of the paperboard industry of which we are proud. It has been only within the past few years that this nation has become self-sufficient in regard to pulp supplies. Any great shift away from the use of wastepaper would certainly upset that balance.

Due, however, to the greater availability of pulp and the constant pressure for quality there has been a relative lessening in the use of wastepaper, particularly for white lined boxboards and food boards.

In order to meet the competition of pulp, wastepaper suppliers are devising better methods of handling and sorting out objectionable materials such as asphalt and sulphur from the waste. This, of course will have the effect of producing a much more uniform and satisfactory raw material with which the board mill can work.

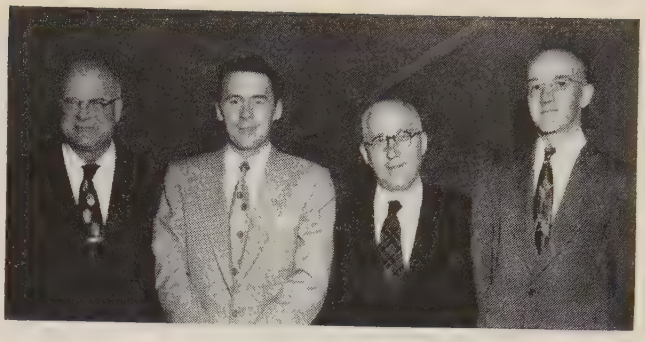
The mills are not standing still themselves, of course, many companies, such as my own, have invested heavily in new equipment designed to remove objectionable foreign material from the fiber furnish. Vortraps, new screens, classifiers, and dirt cones are all part of the effort to produce the quality needed by today's boxmakers.

With it all, however, there are still a host of variables involved, subject very little to mill control. The normal vagaries of papermaking can be compounded fiercely when three kinds of pulps, six grades of wastepaper, of sometimes uncertain origin, and various and sundry chemicals are brought together in an effort to produce paperboard with qualities such as I now propose to outline.

It is impossible to say that any of several major features is more important than the other, so I do not mean by the order in which I present them that we attach more significance to one than the other. These are all equally important.

As in all papermaking, the control of moisture is "paramount" perhaps in board manufacture even more than paper. I recall learning about the hygroscopic qualities of cellulose and the hysteresis curve while I was a student at the Forestry College. Since then I have learned the hard way, of shrinking, cockling, and dimensional instability. To guard against the effects of humid Summer weather, we carry a little more moisture in our board. But we can't guard against the board converter who stores his raw materials in a cold damp cellar then brings it into a warm pressroom to run, or the man who places it in a nice warm upstairs floor where it can proceed to dry out with the above-mentioned undesirable effects.

Board which is too wet may not glue properly; it may



H. D. Cook, Sweet Bros. Paper Mfg. Co.; E. K. Mullen, Robert Gair Co.; H. M. Gray, Sealright Corp.; and F. W. O'Neil, College of Forestry

cockle and warp and make printing a nightmare. In setup box manufacture, it may not score properly. It may shrink so that covers will not fit bottoms or vice versa. Board that is too dry may be brittle, folding grades may break instead of bending and you are ripe for a ride on the hysteresis curve which will leave your board something different than what it was when it started. Moisture control is not an easy thing, but it must be achieved for quality board. According to the weight and end use of the board, and particular customer requirements, we may run moistures ranging from $4^1/_2$ to 5% up to 8 to 9%.

Control of caliper and weight specifications are certainly vital. One doesn't necessarily follow the other but very often variation in one on the machine will indicate variation in the other.

The success of the printing operation and the cutting and creasing operation in folding carton manufacture hinge a great deal on uniform board caliper. It is basic of course, that the actual carton buyer receive the board thickness which he has specified and which he and the boxmaker have decided will do the packaging job. The boxmaker, however, is interested in board which runs uniformly. When his printing press is made ready for a certain caliper stock with the right impression for a good print job, excessive variation can destroy the desired effect. Caliper must be uniform through the run and it must be uniform across the sheet. It requires close and constant machine tending, proper formation in the vats, good stock preparations, and excellent calendering at the dry end to produce consistent caliper control. Without it, the printer hasn't a chance to produce high quality word. Cutting and creasing makeready planned for a different caliper can cause poor bending and the scoring of setup boxes may produce flimsy boxes or ones that will not stay up properly.

Hand in hand with caliper control goes weight control. If the boxmaker cannot estimate costs and receive reasonably the number of sheets per unit weight planned upon, you are in a fair way to make yourself unpopular with him. If weight variation is accompanied by caliper variation you are in. Contrary to what you might think, the boxmaker is not looking for any extra sheets for he knows that if the caliper is right and he is getting a higher count, then the board density is not there, strength features may be less, bending qualities may be poorer, finish and hence printing or lining characteristics may be different.

That brings us to the relationship between weight per unit area and caliper—actually density—which has much to do with the finish or surface characteristics of the sheet. Finish is a much maligned and misused word in the board industry. Some mills are fortunate enough through wet end construction to be able to supply a better "finish" than others. For a given combination of caliper and weight per unit area—again density—the surface characteristics of their sheet may appear smoother than another mill's sheet. However, any mill will have a certain amount of finish variation from time to time

Executive Committee of the Central District: C. B. Martin, F. C. Huyck & Sons; H. D. Cook, Sweet Bros. Paper Mfg. Co.; H. M. Gray, Sealright Corp.; C. E. Foster, Sealright Corp.; F. W. O'Neil, R. G. Hitchings and S. E. Church, College of Forestry

due to the condition of their felts, minor changes in their furnish, and the moisture content of the sheet as it reaches the calenders.

The specific effect, however, is created by the relative calendering which a sheet receives. Other things being equal the harder a sheet is rolled, the smoother the surface will become. In folding boxboards, due to the usual printing and bending requirements which are both affected, calendering is quite hard. Setup boxboards, on the other hand, are concerned more with bulk and rigidity and are generally given lighter calendering. Very often, however, where setup boxes are to be wrapped with highly glazed papers, smoothness becomes quite critical or extra strength is desired and denser boards are required.

I believe it would be well to pause at the calenders for a few minutes to discuss a few of the board surface effects which are created here.

If we are making a bulked up sheet and want maximum caliper with no concern for surface smoothness, we will all but by-pass the calenders. The sheet will be passed through just enough nips to pull it along. If we are making a hard rolled sheet and want maximum smoothness and density, we will pass it completely through each stack. The many possible combinations between the two extremes will give us our range of finishes.

Expert for the bulkiest and dryest boards, most sheets receive treatment with a water box on top or bottom or both sides at the first stack, sometimes called the wet stack or breaker stack. Some moisture is returned to the sheet and with a slipping effect similar to ironing, the surface is smoothed.

With the great variety of inks and printing methods being used today it is often necessary to produce special surface characteristics. Calender treatments of starch, wax, CMC, or combinations of each in conjunction with beater additives are used to make board which will print flat inks with limited offset, or which will keep the "gloss up" on gloss inks, or which will not be disrupted by the water film on lithography. A certain amount of water resistance can be created through surface sizing at the calenders. There are other materials applied at the calenders for which some grease resistance is claimed. Silicate solutions are used to lay board fuzz and to give a glassier looking, somewhat more snappy sheet.

One of the methods of coloring board is to apply water solutions of dyes at the calenders. The matching of colors is an art in itself with the final adustments being made pretty much on a cut-and-try basis. Special customer requirements regarding fading, heat discoloration, and bleeding must be taken into account. Actually the most satisfactory colors from the standpoint of uniformity, coverage, and shade are made in the beaters. Inasmuch as they extend through the liners they are less likely to be troublesome in the case of any small cracks in folding cartons. However, fairly substantial quantities are necessary to justify the expense of cleaning up for beater colors, so that calender colors are found expedient.

A particular feature which seems to be getting more attention lately is that of rigidity or stiffness. We are increasingly asked to control it in one way or the other, and where the orders are large enough to warrant special furnishes, we try to oblige. Stiffness is more particularly a function of caliper, but can be varied appreciably in the same grade weight and caliper through small furnish variations. It has considerable bearing on the strength of the finished carton, but is often subject to limitations caused by automatic forming or filling machines. One result of increasing board stiffness is the necessity to watch bending qualities more closely in folding grades.

Additional to the actual physical quality requirements in the board itself, there are numerous accessory requirements which the mills must observe.

It is necessary to remove as much as possible of the paper dust from the sheets or rolls which is generated at the slitters. If it remains on the board it can detract from an otherwise perfect printing job. There is always the possibility of small pieces of trim or broke getting in between sheets and if carried into the press they can cause considerable plate damage. Sheets must be cut square and very nearly perfect for satisfactory operation on some lithography presses. Where skids of board as they come from the mill are placed on automatic lifts for automatic press feeding, even the piling of the sheets becomes critical. Rolls must be tightly and evenly wound so they will unroll properly on automatic setup or folding inline boxmaking equipment.

Finally, all previous efforts can go for naught unless the board is handled properly and delivered in good condition to the box manufacturer. Most boxboard tonnage now moves via truck which provides for the most part rapid delivery in a satisfactory condition. Folding boxboards and some setup boards which are skid packed in units weighing up to 3000 lb. must be banded with several steel straps to guard against shifting in transit. The most expensive grades of board are sometimes completely wrapped and heavy top frames used, very similar to the packing of fine papers.

The quality features which I have outlined in this paper are the broader more general ones and are required of all folding and setup boxboards. There are numerous other variations and special requirements which are limited in scope but which must be observed for individual users. A substantial portion of merchant board mill tonnage such as ours is used in a variety of manufacturing operations other than boxmaking.

Our type of board mills stand ready to take orders ranging from 1 to 100 tons with equal attention given to each. We manufacture as many as ten different grades of board on a machine during the course of a week's operation and in a wide range of weights and calipers. With over 600 tons per day of paperboard to sell, our machines are constantly at the service of the board user. Like other board manufacturers we attempt to satisfy the twin demands for service and quality. Although failures occur, most converters recognize the variables inherent in papermaking and know that it is far from an exact science. This mutual understanding of each other's problems accounts in part for the success of the packaging industry. I am sure the future will see the same sort of cooperation lead to still higher quality boxboards for more satisfactory packaging.

S. Earll Church, *Secretary*

Empire State (Eastern District)

Smith McLandress of Glens Falls, vice-president of the Appleton Wire Works, gave an illustrated talk on the manufacture and application of fourdrinier wire at the first dinner meeting of the season of the Eastern District Thursday night at Milfrank's Restaurant, Lake George Road, Glens Falls, N. Y.

Mr. McLandress showed a film, "Millions of Miles of Wire," and distributed a booklet, "Wire Facts," on the use and care of the screens in the paper industry. Faulty wires were shown in microphotos and the causes explained.

It was announced that Grant Cole of the Diamond Match Co. in Plattsburgh, the vice-chairman, has been named to head a committee which will make a study on pulp evaluation for the entire year in the district in conjunction with a project of National TAPPI.

Talmage Edmunds of the International Paper Co. at Palmer, was appointed program chairman to succeed Oscar Anderson, Jr., from the same company, who has been transferred.

Earl Johnson of the Stevens and Thompson Paper Co. at Middle Falls, chairman of the committee on junior awards, said the awards will be made in April and advised persons planning to submit papers to start work on them so that a postponement can be avoided. Clyde Davis of Finch, Pruyn and Co. urged all nonmembers who have been attending the meetings to join the state unit.

As an innovation Thomas McGreen of the Research Div. of the International Paper Co. at South Glens Falls, entertainment chairman, provided badges identifying each person attending as to name and firm. Seventy-one persons attended.

"Training Programs" will be the subject of the next meeting, November 19, at Milfrank's.

ALLEN A. LOWE, *Publicity Chairman*

Kalamazoo Valley

The Kalamazoo Valley Section of TAPPI held its first meeting of the season Oct. 1, 1953 at the Hotel Harris in Kalamazoo. About 75 were present.

The speaker of the evening was Henry J. Perry, director of the Wastepaper Utilization Council. His subject was "The Utilization of Wastepaper."

Mr. Perry said the council had its origin in the need of the users, sellers, and inventors of trouble—the wastepaper user, the wastepaper dealer, and the producer of various chemicals, respectively, to get together and develop products that could do the required job, yet be usable or at least detectable in the wastepaper user's plant. Many times just the realization that somebody uses the stock over has been sufficient.

Troublemakers vary as to grade. These are wet-strength resins, asphalts, waxes, polyvinyl inks, adhesives (hot melts), and specialty coatings. Odors sometimes are a problem. In dealing with these, the council has not sought to prevent the use of a product, but to aid in the development of an equal or better substitute, find means of identifying it, or persuading the producer to conserve a valuable source of revenue by keeping it segregated from usable paper. Oftentimes if the producer of a product hard to deink could be told or reminded that it would make the use of the treated paper impossible a caustic soda soluble product might have been made in the first place, as in the case of thermoplastic bindings, or developed through demonstrated need as in the case of the replacement of plastisol ink by one that does a better job yet is deinkable.

In spite of this work, the bad paper will be coming to the mills through back issues for some time to come. There is excellent cleaning equipment available.

On the subject of grade specifications, the mill sometimes makes them, but the dealer usually does. Work is being done to have unusable papers marked. Salesmen of the product educate users to protect themselves by keeping troublesome material out of paper.

One of the big needs at present is the development of a spot wet-strength identifier such as the phloroglucinol test for groundwood.

In conclusion the speaker gave some statistics showing the ever increasing use of wastepaper.

J. A. Dean, Michigan Paper Co.; H. J. Perry, Waste Paper Utilization Council; R. H. Hurst, Kalamazoo Vegetable Parchment Co.; and R. T. Elias, Western Michigan College

After the main talk, Frank Halloran of the Wisconsin Wire Works showed a moving picture entitled "Weaving Wisconsin Wires."

JAMES A. DEAN, *Secretary*

Lake Erie

The Sept. 25, 1953, meeting of the Lake Erie Section was held at Monroe, Mich., with plant trips through the Consolidated Paper Co., Monroe Paper Products Co., and the River Raisin Paper Co.

John Fuko of River Raisin Paper Co. was chairman of the meeting held at the Monroe Golf and Country Club which followed the social hour and dinner.

William Schoenburg introduced the two speakers of the evening, C. R. Anderson, Association of American Railroads, Chicago, Ill., and C. H. Turner, Chrysler Corp., MoPar Plant, Center Line, Mich. Their talks covering "Shipping Damage Preventative Measures" follow.

R. C. MATHEWS, *Secretary*

Shipping Damage Preventative Measures

C. R. Anderson

INDUSTRY has been making quite a number of studies of handling in transit. I have a little chart here put out some few years ago by The Eastman Kodak Co. at Rochester, N. Y. You probably can't see it from there, with railroads here and there, and it eventually comes up on its final dealer's shelf. They have some 42 instances, I might say, incidents, where a package has been subjected to some form of pressure, impact, and vibration forces, and they have tried to differentiate this handling into some of its component factors. Beginning on a roller conveyor, they convert that into a test procedure equivalent to a 4-in. flat drop on any surface. They go through quite a few of those and they come to the ninth stage where it goes into a freight car. Now, it's also interesting to note that even in the freight car as it's being loaded, there are some impact forces put on the package as it's placed on the load, thrown onto the floor, and so on, representing what they would call the equivalent of a 24-in. flat drop on any surface. Now comes the railroad car and the railroad haul involves some transit forces but they are not in a sense responsible for everything. The first trip on this railroad is the equivalent of a 10-min. vibration period and three 3-ft. impacts. That's a pretty good impact. Then, they jump from the 9th incident

C. R. ANDERSON, Association of American Railroads, Chicago, Illinois

C. H. Turner, Chrysler Corp.; and C. R. Anderson, Association of American Railroads

all the way to the 34th incident before it goes on to the railroad transportation again; and again they've given it the same impacts and same vibration they've given it before and so it then goes into its final 42nd state. All along this handling and transfer circuit there are imposed forces and pressures—they're divided up into drops, impacts, vibrations, and compressions during the entire transfer.

Now, you've probably seen this Transportation and Packing Survey which was made jointly by the Classification Committees and the Fibre Box Assn. I'm not going through all of these but they start out with three of the principal factors. First is the shift in load due to improper handling of car in transit. They charge that with 27%. The second biggest item, is poor arrangement of load, 18.6%. Next, shift in load due to loose loading, 15.8%. Those three factors run up to 61.4% of the total in their analysis of the damages that are concurrent in the handling and transportation of a package. They also have some other items, one interesting thing here is boxes and interiors seem inadequate to contents. They only charge that with 5.8%, so possibly you might be able to rest on your laurels. But in some sense of the word, those things tie in, one with the other. I'm trying to establish here that this is a combined responsibility by all concerned.

Now, the hazards in the transportation system itself. I might take a typical case, the well-known RSC box which is probably the one most prevalent, most adaptable, and commonly used container. Speaking as we see it somewhat from the railroad viewpoint. We've spoken the theme of the strength of the box in its various positions for the reason that a box in a load must bear its proportion of bracing forces just the same as if you would put a gate in a car. As we see it, we have the greatest strength in crosswise direction as against the lengthwise direction. You might bear that in mind for a moment. Now, in the car itself, we have three general motions, your greatest forces of impact are in the lengthwise direction of the car, there are some sidewise forces, and you have the vertical oscillation forces which are in transit.

Now, we take this same package and our first thought on the loading of these is in the vertical or what we call the straight stack loading operation. In your warehouse you don't load in a straight vertical stack for the reason that you have lost stability when you go up very high in your stacks with that type of an arrangement. As a matter of fact, in some warehouses I've seen pallet stacking where the containers have been loaded as high as about 65 or more cases high. The damaging part in the transit of this type of a loading arrangement is that the instability of the stacking arrangement throws these into what we call a sawtooth arrangement, and these projecting edges bear against your next package. In canned goods particularly, it provides a source of dented cans. On this basis, we advocate the so-called bonded block system. First, we have a crosswise unit with a unit of lengthwise boxes. The next layer we reverse, so that we put the crosswise on top of the lengthwise and block them up and thus we get into stable units for transit operations.

We have a second pattern in which we place most of the boxes in the crosswise position, to take advantage of the crosswise strength of the box. In this loading pattern, we start with two lengthwise ones, three crosswise ones, two lengthwise ones, and continue in accordance with the size of the box. Now, here we have introduced a system in which we have only two rows of cases in the lengthwise position which is the weaker part of this box, and prevalently most of the boxes are in the crosswise position. A little closer study develops that these boxes overlap so as to hold these boxes in stable position during transit.

Sometimes, according to the size of the box, you run into difficulties and we have to put in what we call a pinwheel arrangement in which we have a pinwheel hole in the center. Actually, this is one of the poorest of the arrangements but we still get into that to maintain our position of cases and filling up space across the car.

Now, in your loading operation, we come into your doorway section which is one of the damaging factors as we've observed and reported in the survey of damaged boxes. If you don't have doorway protection, there is a possibility of the boxes moving out into the doorway section, and provided we get a shift in that load, we can always depend on some of the boxes being torn and snagged on these doorway posts. Now, the thing is, how do we get this movement of boxes in the load? Take an item such as canned goods. We've been advocating tightening up the inside dimensions of the box so that the product fills the more more snugly. What we run up into is quite a bit of space at the ends of the box and also across the length of the box. I've seen those boxes where you could put your hand in and you have as much as $1/2$ to $3/4$ of an in. of space. Another factor is in the stacking operation. When you get boxes that have been stacked 20, 30, or 60 boxes high, the pressure of the cans will indent into the paperboard, both top and bottom. If we start out with space on top plus the weight indentation of the can into the paperboard, we have probably a quarter of an inch or possibly more of space from top to bottom. What does that do in terms of loading? Sometimes it is hardly perceptible but we get bowed sides and bowed ends, as much as $1/2$ in. of bow is hardly discernible sometimes. A very small fraction in the height will extend quite a bit of bow in the case. If we take a half inch of space here at each end or side we get an inch of space. We have another space within the pack. Inside, we have, let's say, another half inch, so we have anywhere from an inch to an inch and a half of space in that container. Now, in terms of the load in the heaviest pressure direction of the car which is lengthwise, it doesn't take a 5th zone impact or so-called 11-mile impact to begin to compress that space out of the case. We begin to lose space at the end of a car, then we get a V-shaped space at the end of the car. There seems to be a greater pressure at the top of the load than at the bottom. There are several reasons for this as I would see it. First of all, in the bottom of the load you have the pressure of your boxes on top to hold it in position, with some frictional resistant forces between the bottom layer and the floor. These end boxes begin to tumble out into that void space and the disarrangement of those boxes plus the possibility of an impact or pressures in the reverse direction begins to crush these boxes.

Some few years ago we began gluing boxes together. It was about the early part of the war, that the armed forces, particularly the Navy, began gluing their boxes together on pallets. Following the war we began a cycle of gluing those same boxes together in a load to keep the boxes together. The difficulty with that, although it is still being used, was the application of the gluing process. It's known as a unitiz-

ing glue, a pallet-type glue. It's strong relatively in shear and weak in tension. It's strong against one box moving over or sliding on the box below but it is weak in tension so that you can pull the box off. Sometimes we've experienced cases where gluing boxes together has been rather awkward. Of course, one of the objections is that this glue in between the boxes causes rupture and tearing of the fiber tissues. Generally the glue lines are applied across the bottom of the box, so that one box on top of the other adheres together; and in breaking them apart you begin to shear and tear those. In a sense, a container might be termed a shipping unit which is expendable but we are coming more and more into the phase where we are not only moving merchandise, we are also moving boxes and these boxes more and more must come into the market and to destination in A-1 condition.

Along this same line, the paper industry came out with the idea of tying the end of the load together. They took two sheets of 40-lb. kraft paper and laminated them together with asphalt and in between the laminations they placed a nylon or spun glass thread which gives it a webbing strength. They've taken this paper in roll fashion, starting down probably at about the quarter section of the car, lay it on the floor, begin to roll it out and then they begin to build in their stacks of boxes. One thing in this relation, it's been rather surprising to note that these boxes in a lassoed sense move as a sort of a solid bulkhead with the shift in the load. We still get shift but with the space in the end of the car, this space is just about as straight as this wall was to begin with.

Another thing in the terms of hazards is, of course, clean cars to prevent soilage and you also get the difficulty of having projecting items. We have several of those. We have the anchor straps that are left in the car and they are just dynamite for tearing boxes. We also come to the point where we get the grain cars. In lining the cars they use these tack hammers and you get thousands and thousands of those little tacks on the walls. They are very difficult to get out and they are showing up as difficulties in the tearing of boxes. Lately, it is being advocated to use glue instead of stoppers in applying this paper for a lining.

Another big hazard factor that we're up against is in the corrugated pleating of boxes from load pressures. These boxes pleat along the center. In some instances they don't do any product damage, particularly in glassware if it's not leaking. But in shipments of canned goods a pleated or creased case generally disarranges the cans within the box resulting in the possibility of dented cans.

Q. Specification for specification, what is your experience in comparing jute to kraft?

A. Well, frankly, from our viewpoint, I don't think the railroad men in the field know enough about the technical points of jute and kraft to distinguish between the two in the terms of a box as a conveying unit for the shipment of merchandise. I don't believe I could give you an answer on which is the best, or how the two might qualify specification for specification. Speaking before the center of the paperboard industry—kraft as we know it, is a strong paper from which they extract as much paper as they can from fiber tissues but kraft has gone from its virgin state somewhat into a combination of things and you come into a state where some of it fluxes into both types, I would say.

Q. Has it ever occurred to the railroad carriers to equip cars with compression members to take up the development space caused by loosely packaged containers?

A. Yes, it has. They have been experimenting with cars in movement, right at the moment one I can think of is the so-called Prati car—this is a refrigerator car—in which they have movable bunker walls. The floor racking as I understand it is interlocked together so that your car lengths are adjusted to the dimensions of the load. But we're up against also the possibility and the actual fact that these cars must be of a general character, and must be used for merchandise cars and the next time possibly for grain and other commodities, so it's not as easy to adjust these cars. We have so-called DF cars, we have auto parts cars, and we have compartmentized cars. There have been cars of this type developed, but we're up against the problem of car supply for a wide variety of commodities.

Q. Do fruits and vegetables shipped in corrugated containers have greater than average damage?

John Fuko, River Raisin Paper Co.; and C. H. Turner, Chrysler Corp.

A. The fiberboard industry is not so old, but some years ago they were struggling to be able to produce enough to meet the markets that came to them. As they grew into maturity they branched out. One of the lucrative fields was perishables. Apples and other deciduous fruits are packed in fiberboard boxes; tomatoes in fiberboard boxes from Florida, Texas, and other parts of the country are pretty well established. More recently they have introduced, and it is still in its experimental stages, the use of fiberboard boxes for citrus fruits. It started with lemons, lemons in a half lemon box, and this has pretty well established itself. From there, they are going to other citrus fruits, oranges, and some grapefruit and more recently they've gone into the movement of lettuce in fiberboard boxes. I said early in my talk that we're coming to a stage where we're not only moving merchandise, we're also moving boxes. Lettuce in fiberboard boxes is still in its experimental stages where we're up against the fact that the lettuce is packed in the field and closed in various manners. It goes into some cooling processes, the vacuum cooled process, and also into some other forms of precooling systems; but as it goes in the car it's in somewhat of an overstuffed condition, instead of having the necessary design features and strength factors of a good box, it's pretty well distorted and the sealing is a little bit difficult. We then arrive at that stage where the lettuce in fiberboards arrives at piers like the New York pier and is removed from a cold car into a relatively hot, humid atmosphere as would prevail on a hot Summer night in New York. The humid air would just soak right into the box, and standing on the pier there you could have a rather miserable presentment of a package from a merchandise viewpoint. I don't say that with any negative sense; I think it will come out all right but it's still in its experimental phase and some of these factors will have to be worked out. If you deliver merchandise in good shape—a head of lettuce may be still in good shape even if the package is damaged—that is the important factor. Or is the appearance of the package more important—is that damage? It's not damage in a sense before it's entered as a damage claim. Possibly industry might get into that factor of demanding a perfect box at destination even though it does not start out that way, and we're beginning to have trouble from that angle and it's still in its early stages.

Package Engineering at the Chrysler Corp.

C. H. Turner

I WANT to thank you first for the big send-off given me and to thank Johnny Fuko for the opportunity given me to meet with your organization. You know, when looking over a group of men like this, I can't help but compare an organization of this type with the human hand. The human hand is composed of four fingers and a thumb and the hand is not complete without each. We can describe the thumb as the manager of the organization, the index finger as the operations

C. H. TURNER, Chrysler Corporation, Center Line, Michigan.

manager of plant head, the middle finger as the sales representative, the third or ring finger as the transportation division, and the little finger as the customer. Then to complete the hand we can consider the palm as the top executives of the organization and the wrist as the stockholders. Now we know that each individual finger has its important and definite function to perform. However, its value and power are dependent upon the cooperation of the whole and when separate from the other fingers, it lacks the strength that could have been had if all the fingers were clasped tight and the thumb wrapped over the fingers, for then we have the real power and cooperation, teamwork and satisfaction. Yes, I believe we can truthfully say that an organization is like the human hand—the fingers and the thumb must be close together for unity, cooperation, and coordination of effort. The support them comes from the palm and wrist, *each* as a part of the whole.

Mr. Fuko asked that I tell you something about our automotive packaging program. He asked that I prepare a paper, but not having had an opportunity to write up a speech and, too, doubting whether I could read it after writing it, I am going to talk to you tonight at random.

I believe that when I first started the Package Engineering Div. of Chrysler I was one of the greenest men that ever entered that field of endeavor. When I was first asked to take over the responsibility of establishing packaging setups, I had to tell my superiors I knew nothing about packaging since my entire business life had been spent in sales and merchandising. However, since being in this field for some time I am of the opinion that sales experience lends a great deal to packaging.

After getting into this work I really found out that there was nothing new as to packaging, for if we read back into history, we find that packaging really goes back to the Stone Age, and if you will remember, when Cleopatra was presented to her lovers she was always wrapped in a nice silken rug. Now that was a really nice package.

To start out on this subject of packaging, I first had to seek to determine what was involved and, too, what we were after. After some analysis, I came up with the following reasons for packaging; first, for protection; second, ease in handling; and third, for merchandising appeal. As we all realized, during the World War II period, commercial or domestic packaging was pretty well neglected, because the automotive industry, as a whole, was involved in production of war materials and equipment, with the result that our domestic end of the parts business had deteriorated considerably. So we knew that a real problem was confronting us, and we had a challenge to meet.

The changing of our folding cartons from one color design to another, and the reasons for accepting our present design of red, yellow, and blue had to be explained. Then, too, diplomacy naturally would have to be used, because we did not in any way want to disparage those who were responsible for our original design of brown dull colors. The question was asked what is your reason for proposing the red, yellow, and blue colors on our folding cartons? Our answer, I believe, is simple and clear. Our blue is a deep blue—almost a royal purple, and as we all know, purple denotes royalty, and Chrysler, in our opinion, is royalty in the automotive field. The yellow strips on our cartons are the same as the yellow you see down the center of our highways as a safety line, which means the Chrysler packaged items are safe items for our customers to buy. Our deep red not only has eye appeal and attaction, but as you know, red means danger. This, therefore, is danger to competition.

Regarding our corrugated or shipping containers, it was decided that plain cartons would not lend anything whatever to the shipments, and that corrugated shipping cartons should act as miniature billboards, therefore our reason for having our corrugated shipping containers printed with the MoPar emblem and corporate name.

Having decided on the three reasons for packaging, the next thing was to determine how and what we were going to package of our many and varied items. We made studies of many packages and found that an unnecessary supply of board was being used and by redesigning such packages considerable savings could be made in material and labor. In some cases we found items were placed in wooden boxes for which, after study and test, corrugated containers were developed to handle such items, which resulted again in considerable savings in material and labor. To cite some examples, our crankshafts, which weigh over 90 lb. and our fluid coupling assemblies, which are quite expensive, are now packaged in corrugated containers rather than wooden boxes.

Of course, before any of these changes in packaging could be made we had to familiarize ourselves with traffic rules and regulations, which calls upon us to work closely with our Traffic Department. Another thing which struck us was the many things involved in package engineering which meant one had to have a knowledge of plant operations and functions, methods, cost analysis, material handling, the functions and purposes of the various types of rustproofing, a knowledge of export requirements for foreign shipments of automotive parts and accessories, and above all—salesmanship. In other words, gentlemen, we had to develop real "imagineering"—that is, engineer our imagination along the right and correct lines.

In starting our Package Engineering Department just after the war we found it practically impossible to employ men with practical knowledge and experience in the domestic packaging of automotive parts and accessories. For quite some time we actually ran a school to train the boys whom we had gathered from our plants whom we felt could qualify.

Just prior to being called upon by your chairman, we listened to a very interesting talk by our friend from the railway divisions in which he mentioned the difficulties and troubles they were having in round cans being placed in square boxes. Such things bring to mind the many problems we have had with our various types of fluids which were canned and bottled and had to be cartonized for care in handling and transporation. Our problems have been difficult due to the thousands of items we handle, including parts and accessories for all the Chrysler products—Chrysler cars, DeSoto passenger cars, Plymouth passenger cars and commercial vehicles, Dodge passenger cars and trucks—from such minute items as screws up to radiators and engine assemblies, in addition to special repair packages which have been developed to make it easier and less costly for our car owners to repair certain assemblies, such as water pumps, fuel pumps, carburetors, and motors.

Apparently the ignorance of myself and those who worked with me on packaging might have been to our advantage, because we didn't know that many things couldn't be done, so we had to go out and do them. By this I don't mean to say that we have licked all of our problems, because we have some delicate and tough details to work out, such as packaging of moldings which in many cases are the width of your two fingers, yet as much as 108 in. in length. The MoPar Division being a service-giving division, we must see that these parts arrive in the hands of our customers in usable condition and at the right place at the right time.

Since you are all connected with carton manufacturing organizations, I might say that our volume of cartons in the MoPar Division for a year is enormous. We use 200, 275, 350, and 600-lb. test corrugated, A and C flute and some B flute for cushioning. The folding cartons are the cylinder kraft type with yellow outer liners, with two-color print jobs, red and blue. I might say frankly we are interested in the salesmen who contact us in being the "go-giving" type and not the "go-getting" type. We need your help in improving our packages and reducing our costs. We must bear in mind that labor today is not interested in savings, therefore our methods of operation are what must be corrected and im-

proved. Again this may be a challenge which the labor unions have placed upon our shoulders and which has to be met.

At this point I am reminded of a Southern story. "One time an old Southern negro had a mule for sale. A prospective white buyer came to examine the mule, so he had the negro turn the mule loose. As the mule started off he bumped into a stump and fell over. He got up and walked a little farther and stumbled over a log. At this point the prospective buyer said, 'That mule is no good—he's blind!' The negro replied, 'No Sir, Mister, he ain't blind—he just don't care.'" That, gentlemen, is the one feeling we are trying to get out of the minds and thoughts of our workers, because we *must* care if we hope to progress and continue to be leaders in the industry. Even though Chrysler may have been the pioneer in the packaging of automotive parts, it's one thing to be a pioneer, but it's another thing to be a leader. There again, gentlemen, is where you fellows come in, by presenting to us your best materials that will do the job at the lowest price.

To simplify our endeavors in the automotive parts packaging, a system has been developed whereby our parts are coded by part type. In other words, bearings, as a part type, would be rustproofed and packaged in a uniform way. Manifolds are all coded according to part type. Ever item down the line—nuts, bolts, screws, lock washers—carry a part type code. This helps us considerably in establishing standardization and uniformity of packaging, for as you know, there are many items which lend themselves to bagging, other to kraft cartoning, while still others must go into heavy corrugated cartons. This also assists us considerably in establishing the types and methods of rustproofing to be used.

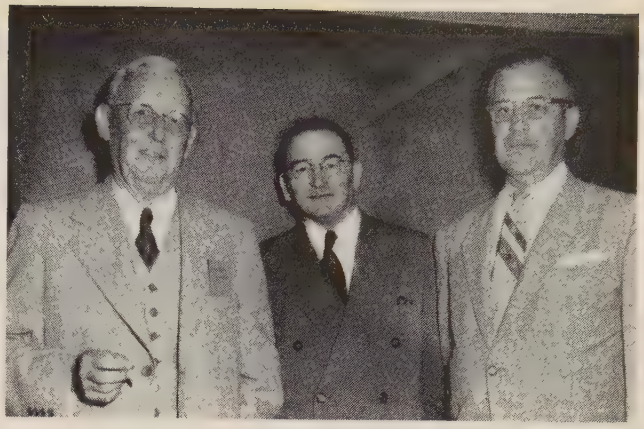
We have gone a step further now, in that we are establishing intermediate or multiple packs, wherein a given number of unit packages, based upon sales frequency, is placed into intermediate packages. This not only adds further protection to the packages, but assists us considerably in filling dealer-customer orders and, too, gets the material into the hands of our dealer-customers in better, cleaner, and more presentable condition.

To further assist in a more efficient operation of handling and transportation, we are getting into the palletizing of packages and materials. From every study we have made, we find there is no demarkation between packaging and material handling. They are so interwoven and interrelated in their functions that one cannot progress without the other.

At the present time we are on an extensive campaign in getting vendors set up to process and package, as we require, in MoPar designed cartons, feeling, that if a part requires protection, then that protection should start at the original source, and when you figure out the thousands of vendors we have supplying us with the many types of items we require, you can realize the vast problem we have here. But, through the cooperation of our Procurement and Purchasing Department, we are making good progress, but still have a long way to go to reach our goal.

There is a new paper on the market called VCI, which is a rust or corrosive inhibitive paper, which we have found in many cases to be far superior to the use of liquid rustproofing compounds on certain types of parts. This, too, requires considerable study, which we are now giving.

Now, to give you a picture of the MoPar Division of Chrysler Corp., which is the service-giving division of the corporation, I might state that we have a brand new, modern, up-to-date, plant located in Center Line, Mich., which is our main parts headquarters, too—our central forwarding point. It is set up and equipped to rustproof and package any and all items. We have a large parts plant located at Marysville, Mich., 50 miles away from Detroit. We have an excellent and very modern plant at Kansas City, Kan., another at Atlanta, Ga., and one at Newark, Del., and last but not least,



Mr. Lockwood, Consolidated Paper Co.; Mr. Raney, Monroe Paper Products; and Mr. Goetze, River Raisin Paper Co.

a splendid plant at San Leandro, Calif. These plants were established at these strategic locations to allow for quick service to our many customers and dealers throughout the United States. Our Center Line and Marysville plants also handle parts lacking for the export field, which means the parts and accessories for Chrysler-built products are shipped to every country in the world. Our inventories of parts and accessories at these various plants run into a considerable amount of money—this, again, to protect the products we have the streets and highways of the world.

An elaborate materials control system has had to be developed, as well as a parts mortality control, so that from past records and past information we can very nearly determine what is required on any part, whether functional or nonfunctional, over a period of years to keep our vehicles in operation.

There are many items, such as large sheet metal parts and doors top panels, which at the present time we are wrapping with specially developed materials. We are hoping that we can come up with a corrugated container of some type which will help us reduce our labor costs of processing such items. Here, again, is where you can prove of value, because we are more than interested in new types of packaging material, new technics, and new packaging equipment which will make our job more efficient, bearing in mind that we never know when establishing a package whether it will be shipped by rail, truck, air, or boat—but it must do the best job for the least money and arrive in the hands of our customer in good usable condition and, too, as needed.

MR. TURNER: Before I get into these questions, I'd like to say one thing we are doing at the present time. We found at many of our plants, when they got packaged material they placed it on top of the old, with the result that the new got out before the old. So now we are date coding all packages and are also vendor coding them. This is done for our purposes and not for the customer, so when we go out to our plants by checking our stocks we can determine if they are rotating that stock. Also, if we do have difficulties or complaints from any of our customers as to the condition of that material, we can always tell from the package who the vendor was that packaged and the date of the package. That's all in code and that has helped us. I don't know if other companies are doing that or not, but we started that four years ago and it has resulted in a big benefit to us.

Q. Do you think that a four-way entry expendable pallet is the ultimate? Is its use imperative if economy and simplicity of design of a two-way entry pallet make it more readily available?

A. Well, let me say this—the only reason we like to have the four-way type pallet, is, because, when placing these on our fork lift trucks to place in location in the freight cars, we want it arranged so that these fork lift trucks can get in from either side. That's the reason we prefer the four-way pallet and by that we mean a pallet with nine legs. We prefer that also because it's easier to handle as some of the aisles in our warehouses aren't too roomy. We've got to be able to get those forks in there to get the stuff out as readily as we can and as quickly as we can and so we would prefer that four-way type.

Q. Have you ever evaluated VPI or VCI applied directly to the sides of corrugated boxes? Would this eliminate the need for interior rustproof wrapping?

A. Yes it would. Now bear this in mind, when I first got on this job, in folding cartons alone we had 356 different sizes. By grouping these now I've gotten down to 101 sizes. So many of these cartons are used on items that are not rustproofed or do not require rustproofing; therefore, that added expense would throw the cost of our packaging up if we were to apply the VCI or VPI directly to the corrugated board, or folding cartons, either one. Now on folding cartons, we had better than 930 different sizes and designs. We got that down to 310 and I'm still not happy. I would like to get it down to 200, because sometimes we can overdo it and I don't think that a quarter of an inch difference in size is going to hurt our package too much. So, therefore, we come to the point, would it be an advantage to us to have the liner board coated with VCI or VPI? It would throw the cost of the carton up and in many cases we would be paying for something that is not needed, particularly so in items that do not require rustproofing or corrosive protection. That's the only reason we haven't used VCI-coated board, because we've had experiments made and we've found that board costs did go up. I hope that answers that.

Q. Of the millions of cartons, how do you break down the dollar value of corrugated cartons and folding grades?

A. Well, of course, it runs into the millions and I can't break that down for you right now. I only wish I had some figures with me; we do have some at the plant.

Q. Do you use the same type shipping containers for export shipment as for domestic shipment?

A. No, we don't. Here it depends entirely upon to which country the package is to be shipped and also on what our underwriters on export shipments will accept from us. At many times we do use wrap-arounds with the water-repellent case liners. In those instances we get the underwriters' acceptance. In other cases, we use fiberboard; in still other cases, we use V or W-type board for export, depending again upon the country it goes to and what our underwriters will accept. Of course, in many cases that involves a selling job on our part, too, to get the underwriters who do accept.

Southeastern

The Southeastern Section held its first meeting of the program year Sept. 25, 1953, at the Frederica Yacht Club, St. Simons Island, Ga. One hundred forty members and guests attended the supper and evening program. Spirits were somewhat dampened by rain and the fact that the barbecue dinner planned for out-of-doors had to be moved inside. Changes in arrangements, however, were very satisfactorily made.

A brief meeting of the Executive Committee was held prior to the regular meeting at which tentative programs for the next meeting were discussed.

Malcolm Pineo, chairman of the local section, presided at the general meeting. He introduced G. W. Brumley, vice-president and resident manager, St. Mary's Kraft Corp., St. Mary's, Ga. Mr. Brumley welcomed the group on behalf of the host mill. Later in the program, Mr. Brumley gave a brief description of the St. Mary's mill, pointed out what visitors could expect to see on the tour Saturday morning.

Other speakers on the program were introduced by Charlie Rogers, vice-chairman in charge of the program.

In his talk on "Research in Tree Improvement at Lake City, Fla.," Kenneth B. Pomeroy, officer in charge at Lake City, showed with completely illustrated color slides, the scientific approach the Forestry Service is using in improving the southern pine. Increased yield per acre, better quality, faster growth, as well as resistance to disease and insects were points discussed.

The important environmental and hereditary conditions are both controlled by careful selection of planting sites, selective cutting and varying genetic factors. Propagation methods used include planting seed from exceptional trees, selection of seedlings, grafting, rooting, pollination, and cross-pollination of various species. The results of these procedures are carefully analyzed by periodic checks of growth and development to guide further research toward the goal of the perfect tree of tomorrow.

Herbert Schweyer, Professor of Chemical Engineering,

Left to Right, back row: C. L. Smith, National Container Corp.; G. W. Brumley, St. Mary's Kraft Corp.; C. N. Rogers, Sunoco Products Co.; Prof. H. C. Schweyer, University of Florida; Glen Kimball, Union Bag & Paper Corp.; K. M. Guest, National Container Corp.; Kenneth B. Pomeroy, U. S. Forest Service. Front Row: Tany Agronin, Black-Clawson Co.; Peter Borlew, Container Corp.; and George E. Scofield, Rayonier, Inc.

University of Florida, presented the paper "Cost Estimation in Process Operation." The paper consisted of three parts comprising: (1) a presentation of the techniques that may be used to estimate the investment costs, (2) those techniques suitable for estimating operating costs for proposed plants and processes, and (3) a discussion of economic balance in selecting optimum processing conditions for different types of operations.

Investment costs of a new plant are made up of the physical equipment costs, the cost for land, working capital, and others. A reasonable estimate of the total investment can be obtained from limited engineering data by means of certain ratios based on the known cost of the major equipment items.

Similarly, from a knowledge of the prime cost requirements for materials and labor in operating a process, a reasonable estimate of the over-all manufacturing cost can be made. When the fixed charges are added, the total cost of sales can be approximated to provide the necessary final data for evaluating the economic feasibility of a proposed plant or process.

In design of equipment or in operations where the equipment is already installed an economic analysis will often show that minimum costs can be obtained by a judicious selection of certain critical conditions. Examples are the selection of insulation on steam lines, the number of effects in multiple effect evaporation, the recovery of valuable materials from waste streams, the size of inventories, etc. When each of the costs pertinent to the operation are plotted against some common variable, and one or more of the costs decrease while the others increase, an economic balance exists. Where an economic balance is indicated, an analysis will show that a minimum cost for the operation can be obtained at some optimum value of the common variable. Such an analysis may be carried out in a graphical stepwise manner or by means of mathematical relationships.

The successful use of economic techniques and procedures of the type discussed above permits the process engineer to evaluate suggestions or new procedures with potential savings or earnings that may be of considerable value over a period of years.

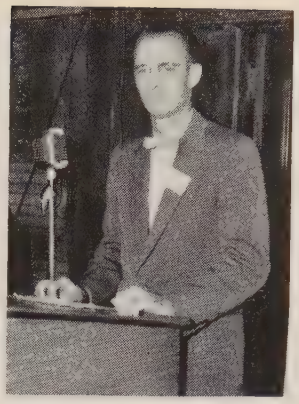
Tany Agronin did a fine job in substituting for J. H. Pearson of the Black-Clawson Co. in presenting the paper, "Automatic and Remote Control Applications for Stock Preparation Systems."

Mr. Agronin stated that as the preparation of paper stock evolved from the period of pure art to a combination of art and science which it is today, it was necessary to develop or adapt proper control equipment to insure the production of a suitable finished board or paper as well as the control of papermaking constituents.

By means of a series of slides and accompanying discussions, the speaker described several types of automatic control devices and their applications. These were as follows: (1) remote control of paper machine stock flow, (2) automatic level control for broke hydropulpers, (3) automatic distribution of stock to various locations, (4) automatic consistency and jordan control methods, and (5) various other control systems.

Mr. Agronin, in concluding, emphasized the importance of centralizing machine controls with respect to reduced labor requirements.

C. L. Smith, *Recording Secretary*



G. W. Brumley, St. Mary's Kraft Corp.

H. C. Schweyer, University of Florida

Research in Tree Improvement at Lake City

Kenneth B. Pomeroy

The genetic improvement of forest trees has become a subject of considerable interest in the Southeast, initially as a means of securing better gum yields for the naval stores industry, and more recently to improve the quality and growth rate of timber used for lumber, pulpwood, and other forest products. Tree improvement is a long-term undertaking that can be accomplished progressively in several stages of varying complexity. Some phases of the program already are being applied by forest owners on a commercial scale. Other phases, particularly those involved in mass production of superior strains of seedlings must await development, through research, of much fundamental knowledge. The various steps to improved forest trees are:

1. Selection of good parent trees in stands to be regenerated naturally.
2. Reservation of the best present stands for production of seed needed in artificial reforestation of denuded or understocked forest land.
3. Cooperation in region-wide studies to identify racial or geographic strains best suited to a given locality.
4. Search for "elite" trees from which to develop better strains of fast-growing, high-quality trees adapted to specific site conditions.
5. Testing the progeny of "elite" trees to see if they are genetically superior or only the product of a favorable environment.
6. Vegetative propagation by rooting cuttings or grafting.
7. Controlled breeding techniques.
8. Hybridization or crossbreeding between and within species to develop superior strains.
9. Mass production of superior seedlings.

NATURAL REGENERATION

Natural reseeding following harvest cutting by the seed-tree system is not only the most economical way to replace the present stand of timber but it is the method in greatest use today and probably it will continue to be for a long time to come. It also offers woodland owners the best opportunity to practice eugenic forestry easily, cheaply, and successfully. This can be done with only slight modifications in the application of the seed-tree system, which at present varies all the way from very poor to excellent, depending upon the inclination of individual woodland owners.

In marking seed trees, it is natural to favor fruitful trees in the smaller diameters if any are available. This reduces the investment in residual timber and also permits a bigger cut per acre. On the other hand, the trees with the most cones may not be those of the best quality and fastest growth rate. Sometimes poorly formed, undesirable trees produce heavy cone crops, while exceptionally vigorous trees occasionally may be light seed producers.

In seed-tree cuttings in Florida and Georgia loggers usually leave 3 or 4 seed trees per acre to restock the land. These trees usually are intermingled with any rough, unmerchantable culls that may have been present. These culls should be felled or poisoned to eliminate them as a source of pollen or seed for a new stand. Both the genetic and economic outlook will be improved if enough good parents can be left to adequately restock the entire cut-over area with the first seed crop. Delayed regeneration means loss in annual increment. The extra seed trees can be harvested 2 or 3 years after reproduction becomes established.

Another consideration is that a seed-tree operation without prior stand improvement may be akin to starting a cattle ranch with range heifers which have already been bred. Some of the offspring may be scrubs. So the seed tree or regeneration cut should be preceded by an improvement cut in which all stunted, deformed, diseased or insect infested trees are removed. This culling operation should occur before the cones are pollinated, so that both male and female parents will be of the best specimens available. If this is done 3 or 4 years in advance of the time when a new seedling crop is needed, the partial opening up of the stand may provide an additional benefit by greatly increasing the production of cones. Cone production is stimulated when the crowns of seed trees are exposed to more sunlight by removal of the intervening trees.

ARTIFICIAL REFORESTATION

The increasing emphasis on reforestation of idle land has forced nurserymen to accept tree seed from many sources although they recognize the need for seed of proved quality. This situation could be improved materially by confining cone collections to the best available stands and providing for a certified seed program in each state. Landowners with large planting programs might profit by using their best woodlands for seed production.

Stands selected for seed production (*2*) should be even-aged, well-stocked, uncut, second-growth stands of natural origin. Under such conditions the thriftiest individuals will be the dominant and codominant trees by virtue of "The survival of the fittest." In such a stand one should first remove all trees with undesirable characteristics such as: (1) deformed, crooked, twisting, or forked stems; (2) stunted growth; (3) heavy, persistent branches; (4) diseased or insect-infested trunks or crowns; and (5) rough, knot-covered boles.

The remaining stand should be reduced to approximately 20 to 30 of the best trees per acre. These trees should: (1) be straight, well-formed, clean-boled trees with full even crowns; (2) be evenly distributed throughout the orchard so that each tree can attain maximum crown development and fruitfulness. This means an average spacing of 35 to 40 ft. between trees;

Kenneth B. Pomeroy, Officer in Charge, Lake City (Fla.) Research Center Southeastern Forest Experiment Station.

(3) have a good rate of growth as determined by increment borings or by close observation of the bark to see if it is expanding rapidly. Trees selected for seed production should be at least 50% larger in wood volume than the average of the trees in the stand.

These natural cone-production areas can be replaced later with seed orchards of superior trees developed through forest genetics research.

IDENTIFICATION OF RACIAL STRAINS

Failure to apply available knowledge concerning racial strains in some species and lack of precise information about other species probably is penalizing current reforestation efforts severely. There is strong evidence that the geographic source of seed is reflected in the subsequent growth of planted Douglas-fir (*3*), ponderosa pine (*7*), and loblolly pine (*6*). In the latter study Wakeley found that "Pulpwood yield of trees grown from Arkansas, Georgia, Texas, and local Louisiana seed 22 years after planting were respectively 15, 18, 23, and 42 cords per acre." These results indicate that the presence or absence of racial strains of slash and longleaf pine should also be determined.

In 1951 a region-wide test of loblolly, shortleaf, longleaf, and slash pine seed from widely separated forests was begun under the guidance of the Committee on Southern Forest Tree Improvement. One of these seed-source plantations is at Lake City, Fla., and contains slash pine from South Carolina, Alabama, Louisiana, north Florida, and central Florida. Although these seedlings were all grown in the Olustee nursery and planted nearby on a uniform site, there are strong indications that central Florida stock is not as well adapted to Lake City conditions as the other four seed sources. This is the first direct indication that racial strains may exist in slash pine and in turn it has led to a more refined test in which seeds were obtained from 15 localities in Georgia, Alabama, and Florida. The extent of each of these 15 zones was determined in advance of cone collection by careful examination of climatic records, soil maps, and species distribution charts.

When the extent and location of good seed collection zones are determined, the public should be protected by means of a certified seed program administered by some central agency in each state. In fact it would be very helpful to private nurserymen right now if they could obtain seed of known origin, purity, viability, and count per pound. This information would simplify sowing estimates, provide better control of seedbed density, and help nurserymen to produce more uniform seedlings for machine planting.

FINDING "ELITE" TREES

The three phases of tree improvement already described are primarily of benefit in preventing the degradation of present stands such as occurred during the "high-grading" or "clear-cut-and-get-out" methods of a generation ago. The next major step is to improve the rate of growth, disease resistance, drought or frost hardiness, and other desirable qualities of our forest stands. This can be done most easily by locating those rare specimens which by a fortuitous combination of inherited characteristics are far superior to the average tree. Some exceptional trees have already been located.

In 1942 an intensive search was made through the gum belt for exceptionally high-gum-yielding slash and longleaf pines. After checking thousands of records, 12 such trees were finally selected for their ability to produce more than twice as much gum as the average trees. These trees have been used as parent stock for breeding and propagation tests at Lake city in an effort to develop better strains of pines for turpentining

"Elite" trees of superior growth, high quality, drought hardiness, and disease resistance are needed also for the benefit of other forest industries. An appeal has been made to foresters, woodland owners, and timber operators throughout the Coastal Plain of Georgia and Florida to watch for and preserve outstanding longleaf and slash pines. To qualify as an "elite" tree, a slash or longleaf pine should have a straight, clean bole of good merchantable length, and a well-proportioned crown. In growth and size it should be better than other trees of the same age in that vicinity. It should have a vigorous, healthy appearance and be free of any evidence of insect or disease attack. Such trees should be reported to the Southeastern Forest Experiment Station, Box 92, Lake City, Fla., for careful evaluation and later use in propagation and controlled breeding of better strains.

PROGENY TESTING

The initial evaluation of "elite" trees must be made on the basis of visible factors such as size, form, or freedom from disease. By wounding a slash pine in midsummer and observing the resulting flow of gum for a 24-hr. period, a preliminary estimate of its gum-yielding potential is obtained. Growth rate can be estimated by extracting a core of wood and noting the width of annual rings. If the proportion of springwood to summerwood in each annual ring is also measured, then an index to wood density becomes available. But there is no way of immediately estimating how a selected tree would develop on another site. Probably it would be better or poorer than "elite" trees found elsewhere. So it is necessary to assemble representative samples of all selected trees on a uniform site for direct comparison of inherited traits without the confounding influence of different environments. This can be done vegetatively by rooting cuttings or grafting twigs on seedling root stocks and setting them out in test plantations. Both the rooted cuttings and the grafted scions will develop in accordance with the genetic traits of their individual parents.

After the genetic traits of two trees are combined through crossbreeding, additional progeny tests are made to determine the reaction of the new biotype to different environmental conditions. For example, slash pines that grow rapidly on moist soils along the coast of Georgia might not even survive on dry sandy ridges in Florida. Healthy seedlings from Florida might become severely infected with cankers if planted in some parts of Georgia. So, as each new biotype or strain is developed, test plantations should be established on a variety of sites in different localities.

The progeny testing phase of species improvement cannot be short-cut or hastened appreciably. Some traits such as rate of growth or yield of gum can be estimated within 10 years. Other factors such as insect or disease resistance, and drought or frost hardiness may require a full rotation for complete evaluation.

VEGETATIVE PROPAGATION

Very little was known about propagating, grafting, or controlled breeding of slash and longleaf pine when the species improvement program was commenced by H. L. Mitchell, K. W. Dorman, and others at Lake City a decade ago. Consequently, most of the effort since then has been in development of practical techniques.

Cuttings of slash and longleaf pines can be rooted during the dormant or early winter season by placing freshly cut twigs in a propagation bed of vermiculite and sterile sand. The propagation bed must be kept moist and warm to stimulate growth; and a high humidity must be maintained around the cuttings to keep them from drying out. Consequently this method of propagation must be done under controlled conditions which in turn place limitations on the extent to which the method can be used. Only a few slash and longleaf pine cuttings were rooted during early attempts, but recent trials have been 30% successful.

A more promising technique known as airlayering has been developed within the past year. In this method, roots are induced to form on twigs before the latter are severed from the parent trees. Each twig is girdled by removing a narrow strip of bark, a growth hormone is sprinkled on the wound,

and moist sphagnum moss is held in place around the wound with a plastic sheet until roots develop. Initial tests were very successful and have an additional advantage, as the method can be used during the normal growing season.

Good results also have been obtained in grafting twigs of large trees onto seedlings, in transferring growing tips from one seedling to another, and in grafting seedlings back into the crowns of mature trees. Various types of cleft, veneer, approach, and bottle grafts are used. Some of the most successful grafting methods, and of course all those involving large trees, have been done out of doors. During the dormant season much of the work with twigs and seedlings is done in a greenhouse so that growth may be stimulated.

All these methods of vegetative propagation are useful in estimating the genetic makeup of individual trees, in shortening the normal breeding cycle by stimulating flowering of twigs and seedlings, and in the ultimate establishment of seed orchards. But vegetative propagation does not provide a means of improving tree qualities, as each offspring can be no better than its parent. To get even better trees than those now available in nature, it is necessary to go a step farther and resort to controlled breeding.

CONTROLLED BREEDING

Controlled breeding is a painstaking process in which the pollen of one tree is transferred to the female cones on another in an attempt to combine the desirable traits of both parents. In practice this requires frequent trips to the tree tops during January and February to gage the ripeness of pollen and the receptiveness of young cones. At this time the female conelets are covered with plastic or canvas bags to prevent accidental contact with stray pollen. Just before maturity the pollen grains are collected, dried, and placed in sealed containers until needed. Pollination is accomplished by injecting pollen through a syringe into the bag and around the conelets. After each such use, the equipment must be sterilized to prevent contamination in subsequent breeding.

Pollinated cones require about a year and a half in which to develop. During this period they must be protected from insect and squirrel attacks. In the fall of the second year the cones are collected, the seed extracted, and thus a new cycle of life begins.

Although efficient methods of controlled breeding have been developed, it can be seen that this is a slow and laborious process. Consequently its principal value lies in development of hybrids of known parentage. Once a superior strain has been developed and tested, the seed for reforestration purposes can be produced by interplanting scions from the "elite" parents so that they may cross-pollinate naturally.

HYBRIDIZATION

The phenomenal results obtained with hybrid corn and other cultivated crops beckon the forester to make similar trials with forest trees. A number of experiments have been undertaken both here and abroad and some favorable results have been obtained (*5*).

Usually, hybrids develop midway between that of either parent, in which case the hybrid would be planted in place of the poorer parent. In the Southeast we would like to obtain a hybrid longleaf pine that could withstand the droughty conditions of dry sand ridges and at the same time begin the prompt height growth of other pines. There are some indications that such a desirable hybrid may be possible by crossing longleaf pine and slash pine. The few seedlings from this cross that have been grown at Lake City, Fla., at Placerville, Calif., and at Bogalusa, La., have all made acceptable height growth without going through the familiar grass stage of longleaf pine. This possibility is being tested more thoroughly in current breeding work.

MASS PRODUCTION OF SUPERIOR SEEDLINGS

Readers who have persisted to this point probably have concluded that mass production of special seedlings is a long time away. Actually that day is not so distant for the naval stores industry. Seed orchards can be maturing while the various progeny tests are in progress. A little more background information and an example will show how this can be done.

K. B. Pomeroy, U. S. Forest Service

Tany Agronin, The Black-Clawson Co.

Anatomical studies at Lake City disclose that gum flow is governed by the size and number of horizontal resin ducts, the viscosity of the gum, and perhaps the internal pressures that force gum from a wound (*4*). Resin ducts can be counted and measured accurately by examining a small section of wood under a microscope; and viscosity can be determined in a laboratory without much difficulty. Each tested pine of about average yield contained one or two of these desirable features but no tree contained all four.

Now suppose tree A has very large resin ducts but is only average in other respects while tree D has many ducts of normal size. If these trees are crossbred, many of their progeny should have a better than average number of ducts midway in size between parents A and D. If one parent also has thin, fluid gum while the other has high internal pressure, it is logical to expect many of the offspring to be high-gum yielders. In fact it has already been proved that gum yield is an inherited characteristic in longleaf pine (*1*).

In practice the geneticist interprets his theories in the light of knowledge derived from fundamental studies such as the anatomical factors governing the rate of gum flow. The special propagation and breeding techniques outlined earlier enable him to set out plantations which ultimately will become seed orchards. Since the genetic make-up of a seedling cannot be foretold, the geneticist will also plant stock from other "elite" parents. As soon as progeny testing reveals the best gum producers, all that remains is to cut down the unwanted trees. The result is a seed orchard of superior trees from which seedlings can be produced by conventional methods.

CONCLUSION

The growing interest in species improvement exhibited by the pulpwood industry and other forestry-minded organizations is gratifying to those few pioneers who have staked their professional careers on the possibilities of forest genetics. At the same time this upsurge of interest creates a sense of misgiving, a fear that the public may be oversold. Many years, perhaps decades, must elapse before landowners can order from their nurserymen "elite" strains of fast-growing trees adapted to specific site conditions.

Nevertheless, definite benefits await those who practice eugenic forestry by removing undesirable trees in stand improvement cuttings, leaving only the best seed trees for stand regeneration, and planting seedlings of the best available local parentage. These three fundamental practices lead to progressive improvement in timber quality while landowners

are awaiting the deferred benefits of controlled breeding and hybridization.

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Maine-New Hampshire

The following papers were presented at the meeting of the Maine-New Hampshire Section which was held at Poland Spring, Me., June 19, 1953.

Coated Papers and the Lithographic Process

John D. Payne

THE history of lithographic coated papers spans a scant 20 years. Two decades ago lithography was generally regarded as a process for printing wove paper surfaces, and coated paper was run regularly in but a handful of shops. Management and personnel of the average litho establishment shunned coated offset paper, and regarded it as difficult to handle. There were good reasons for this.

First, there was little familiarity with handling a coated sheet.

A second reason was the lithographic plate. In the middle thirties the plate was apt to be poorly desensitized, and the nonprinting areas often contained residual albumen scum, ready to take ink at the slightest encouragement. To combat the poor desensitization, tacky inks that would "pull the image clean" were in vogue, together with low pH press dampening solutions. The tacky inks imposed high strength requirements on the coated paper, and often caused tearing of the sheets or caused them to pull out of the grippers and stick to the blanket.

The blankets themselves were a third reason lithographers had difficulty with coated papers. These blankets were usually compounded with natural rubber. Ink vehicles and poor blanket washes caused the blankets to swell and emboss, resulting in poor prints and misregister. Then, too, a blanket could be depended on to do one of two things: become tacky or become glazed. Either of these conditions allowed poor release for smooth coated surfaces.

A fourth reason was the lithographic ink which was then a pigment ground in bodied linseed oil. The ink was supplied in a very stiff formulation, and the pressman reduced and doped it to his idea of a proper mixture for the job and paper at hand. No two pressmen had the same idea, so results were often highly interesting, if purely from a spectator viewpoint.

A fifth reason was the litho coated paper. The paperman's compromise answer to the widely varied shop practices was a hard, often dingy, clay-casein coating on a long-fibered well-hydrated sheet. The attempt was to meet the strength requirements of the process. But the resultant sheet was cranky to moisture changes. Its high hold-up and slow ink vehicle drainage were prone to offset. So the pressman ran his ink spare and got a gray, washed-out print. He doped his ink with cornstarch, wax and oil, and got into ink chalking and drying problems.

Thus, by the dawn of the forties, the average lithographer regarded a coated paper job as an incipient headache. But there were a few loyal men who firmly believed that lithography was a process capable of the finest black-and-white and color reproduction. Such work would, of necessity, be done on coated papers. The numbers adhering to this school of thought grew, and, of course, today their point is well proved.

During the last 20 years there have been hand-in-hand developments of lithographic techniques, inks, and coated papers.

Better plate desensitization and more durable image areas have enabled the pressman to run less tacky inks and higher press water pH.

Improved blankets, utilizing synthetic rubbers, have practically eliminated embossing, tackiness, and glazing problems. Blanket surfaces have been developed to provide good paper release and minimize dusting and blanket build.

The inkmakers have made vast strides with resins and synthetic varnishes. Their quicksetting, less tacky inks run clean—and right from the can. The task of ink formulation has rightfully been transferred from the pressman to the ink chemist.

Papermakers have thus been enabled to supply the lithographer with better coated paper because of the more standardized and improved practices. At the same time, our industry has not been standing still in the field of new developments. New adhesives, notably starches, and new pigments have resulted in strong bright coatings with high ink affinity, good ink-drying characteristics, and attractive appearance. Body stocks have been treated to keep crankiness at a minimum.

All these developments have been gradual, and some in fact are far from new. Overwhelming acceptance by the lithographic industry, however, has occurred since World War II.

What makes a good lithographic coated paper?

Peculiarities of the lithographic process impose special requirements on printing papers. Papers well suited for letterpress or gravure may not be suitable for lithographic printing. While many of the requirements of good lithographic paper are identical with those of good letterpress paper, certain paper characteristics become much more critical for successful use with the lithographic process.

Probably the foremost requirement for lithographic coated paper is its strength. Lithographic inks are generally tackier than letterpress inks, and thus exert greater pull on the paper surface. Press cylinder surface speeds, of course, vary considerably, but, in general, it may be said that lithographic speeds are higher than letterpress speeds for a given sheet size. Paper for lithography must be well bonded to resist rupture or splitting and must have a surface that will not pick at commercial speeds with typical commercial inks.

Another critical characteristic of a lithographic paper is its water resistance. The surface of the paper must not be susceptible to the moisture of the lithographic blanket during the moment of impression in such a way that coating or adhesive dissolves, or the quality of the print is readily affected by very minor changes in the quantity of press water.

No undesirable chemical reaction may occur between a good lithographic paper and the press water and press plate. Components of the paper which would tend to react or to change water fountain pH must be shielded or imprisoned in the paper so they are not chemically free. These three requirements—strength, waterproofness, and freedom from chemical reaction—are equally important in commercially acceptable lithographic paper suitable for long runs and all types of work.

There are other important physical requirements that good paper must have in order to be commercially acceptable

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for lithographic use, or for that matter, printing use in general. Some of these requirements are even more important to the lithographic process than letterpress. One of these is paper moisture content or, more important, the atmospheric relative humidity with which it is in equilibrium. Dry paper can give rise to static difficulties in feeding and delivering. In addition, since paper tends to pick up some moisture on the offset press, changes in sheet dimensions are very apt to occur when running dry paper, with resultant misregister. Wavy-edged and tight-edged paper usually give infinitely more trouble with the lithographic process than with letterpress since the lithographic blanket irons out the whole sheet.

Paper suitable for automatic feeders must be flat. Structural curl and roll set may get by in hand-fed or slow-speed equipment, but are bound to cause costly delays on high-speed presses. Dimples and spongy paper or uneven piles will also cause feeder difficulties. Accurate trimming is a requirement for many modern feeders. Square edges are prerequisites to good register; concave or convex edges will give trouble.

Foreign matter in the paper coating or body stock, if improperly bound, may result in pickouts. Loose dirt of any nature in the paper is highly undesirable.

Ink setting is a most important characteristic of any coated litho paper. This is its ability to drain vehicle from the ink, causing it to "set." There are three functions of a coating which influence ink-setting time: ink affinity, drainage rate, and drainage capacity. Some papers such as varnish-grade labels are specifically designed to have high ink-setting time (or slow drainage) to afford maximum vehicle hold-up in varnishing or gloss ink work. At the other extreme, some papers have rapid vehicle drainage (or low ink-setting time to afford rapid drying, freedom from offsetting, and maximum tonal reproduction fidelity. There are, of course, many levels of coated paper performance between these two extremes.

A pressman should familiarize himself with the particular characteristics of the paper he is running on a job so that he can anticipate results. Many inks will not give comparable results on all coatings, and if characteristics of a coating are not understood, trouble may result. Offsetting, loss of brilliance, loss of gloss, chalking, and poor drying are typical of this type of trouble. Where any doubt exists, paper should be submitted to an inkmaker so that he may formulate an ink that will give the desired results.

Probably current coated litho papers could not meet strength requirements of the 1930's. But while press technique and associated developments in inks and blankets have enabled us to supply litho coateds superior to those of two decades ago, the paperman's problems still exist. Some of these problems are new; others are old problems in a different form.

Modern litho presses can lithograph 76-in. sheets of paper at high speed. While cylinder diameters have been proportionately reduced, paper surface speed is very high. Past history shows no reason for belief that maximum sheet sizes will stop at 76 in.—another 5 or 10 years may well see us furnishing litho papers in even larger sheet sizes. This presents a huge problem in regard to register and dimensional stability. Multicolor presses, fortunately, tend to minimize the problem. It is more difficult to manufacture over-all sheet flatness in larger sizes. Large sheet sizes also increase the amount of paper we must discard for each imperfection.

Let us examine some typical problems encountered in lithographing coated paper.

Pickouts. These may be lumps of color, or foreign matter in the coating or body stock. Insufficiently bound, they pick out on the rubber blanket. Sometimes they disappear in a few sheets, but often they remain, causing blemished prints until removed by the pressman.

Cutter Dust and Loose Dirt. These are particles that pick off the surface of the paper and stick to the blanket. The resultant blemish is much like that of pickouts.

Blistering. When the pull of the litho ink exceeds the paper bond strength, the surface will blister. Reduced ink tack and press speed or higher bond strength are the solutions.

Coating Pick, Tail Pick, Blanket Build, and Dusting. When the pull of the litho ink exceeds the coating strength, coating pick results. This usually begins as "tail pick" at the point of ink release, namely the trailing edge of solids, type matter, and halftones. In severe cases picking becomes general over the printed surface. The coating sticking to the blanket mixes with the ink, producing a puttylike mass which will not transfer. The increased pressure at this point reinforces the picking tendency. Blanket build or piling can also result without evidence of coating pick. This comes from loosely bound coating, dusting into the ink and changing its consistency so it will not transfer. Sometimes, this dusting is general all over the blanket. The pressman meets this problem by frequent press stoppages and washups. A softer ink may help at the expense of reproduction fidelity.

Ink Offsetting. In general, offsetting is caused by excess ink vehicle remaining on the paper surface while the succeeding sheet presses or drags on the wet ink. It may be a paper, ink, or mechanical problem. If ink-setting time for a lot of paper is unusually high for its particular grade, the blame rightly falls on the paper manufacturer. Otherwise, it is up to the pressman and ink maker to formulate and apply the ink in such a way that offsetting is avoided.

Ink Drying. Drying of litho inks is affected by temperature, moisture in the paper and in the atmosphere, paper surface pH, press water pH, and the amount of drier and oxygen available. Ink drying complaints are nothing novel to paper manufacturers, but we are infrequently to blame. In most instances the cause will be found in the pressroom. However, excessively moist paper, low surface pH, unusually low ink-setting time, or incorporation of nondrying oils and waxes in the coating can result in ink drying troubles.

Ink Glossing. Printing buyers are increasingly gloss conscious, and gloss inks are commonly used to create an effect. Paper properties enhancing ink gloss are surface smoothness and high holdup, or slow ink-setting time. Fast ink-setting papers will give inferior gloss characteristics. New ink formulations give promise of high gloss while permitting rapid vehicle drainage, thus minimizing offsetting and blocking difficulties.

Misregister. Papers whose dimensions are readily affected by moisture variation present multicolor register problems. Some furnishes are more susceptible to dimensional change than others. Misregister can also arise from the pull of heavy elements on the printing form. Again, certain furnishes are better able to resist mechanical strain than others. In misregister complaints, the paperman should always check guide and gripper edge of press sheets to be certain that the register mechanism of the press is performing properly. Flat paper, at or slightly above equilibrium with pressroom atmosphere, and with straight square edges, is a prerequisite to good register work.

Embossing and Hooking. These conditions in printed paper are caused by distortion of the paper exceeding its elastic limit during separation from the inked blanket. The higher the ink tack and press speed, and the lighter the paper, the more will hooking and embossing result. Less tacky inks, slower press speeds, minimum pressures and stronger paper furnishes help correct the condition. Hooking and embossing frequently cause offsetting, and give trouble in the press delivery and in finishing operations such as trimming, die cutting, and labeling.

Paper Curl. Paper curl may be structural or due to moisture changes. Curled paper in the pile causes difficulty in feeding and loss of printing production. Paper curling upward at the edges or back in the press delivery is frequently a sign of excess press dampening water.

Antioffset Spray. Wet or dry spray, used to prevent ink offsetting, is a frequent source of unjustified paper complaints when improperly used. Microscopic examination of printed sheets generally reveals the source of the trouble. Photomicrographs can be used as documentary proof to absolve the papermaker from blame.

Mealy Prints. These may be rarely caused by a paper surface with poor ink affinity, or one unduly susceptible to press water influence. Usually, however, they are due to blanket pressure insufficient to insure proper ink transfer from plate to blanket to paper. There is still some reluctance among pressmen to use adequate pressure on coated papers. In other cases, a new blanket which prints well at the start is compacted during a run with resultant loss of printing pressure. Poor plate images or excess press water can cause similar mealiness in solid areas.

Scumming. Coated paper may be the cause of press plates scumming, or taking ink in the nonimage areas. Dusting of alkali-reacting materials on the press blanket will be likely to raise the pH of the film of water on the plate surface and gradually work back to influence a pH rise in the press water fountain. A similar condition can result from coated surfaces which have an excessively low water contact angle. Normal litho coating formulations have been engineered to eliminate paper-caused scumming.

These problems, I can assure you, are by no means the only ones involved with litho coated papers. Perhaps they are enough to make a young man think twice before jumping at the opportunity to become a litho pressman, or an ink or paper chemist. But the many beautiful and brilliant jobs being successfully lithographed on coated papers at high speeds demonstrate the long trek forward made by all of us in the graphic arts industry during the last 20 years.

Some Things We Would Like to Know About the Printability of Boxboard

H. W. Verseput

In order for those of you who make paper to appreciate some of the printing problems encountered by those of us who make boxboard, it might be well to spend a moment on the nature of boxboard, its manufacture, and uses.

In the first place, most folding boxboards are made from wastepaper, a material not notable for consistent quality, even within any one of the 42 standard grades. A variety of these grades may be combined into each of the four plies usually composing a cylinder board. These four plies may total 16 points, or over 40 points, and the board may be had in a variety of liner colors and finishes.

Since such a multitude of combinations of furnishes, calipers, colors, and finishes are possible, it is small wonder that board is seldom produced for stock. Instead, each order is custom-made for a particular job, and quite often, to a particular customer's specifications. As a result, mill runs are relatively short, and machine changes are frequent. The mill laboratory is kept fairly busy seeing that the basic specifications are met, and any check on printing quality will have to be quick and easy.

Printing a folding carton is not quite the same as printing a magazine, either. Customers are extremely particular about the appearance of their cartons, especially where color is concerned, some even going so far as to specify a color by a spectrophotometric reflectance curve. As a result, the boxmaker finds himself with a wide variety of inks, each intended for a particular job and compounded by the ink maker to match a standard sample. In such a situation, it is usually desirable that the ink formulator have a better eye for color than the customer, but unfortunately, such is not always the case. To some, gloss is also important, and of course, sharpness and general high quality of reproduction are always to be desired.

H. W. Verseput, Robert Gair Co., Inc., Research Laboratory, Uncasville, Conn.

Factors Influencing Printability

Since the back-tender of a board machine is already fairly busy watching moisture content, caliper, finish, and sheet cutter sizes, it would be highly desirable to have a little black box that would keep track of printability for him. He would just drop in a small sample, and the black box would indicate whether or not it was of suitable quality for printing, and why.

Now, having established the basic nature of our test for printability, all that remains is to work out the details—just what are we going to put inside that little black box?

It is generally considered that the properties of board having the most influence upon the way it will print are the following: (1) ink penetration, (2) smoothness, (3) compressibility, and (4) surface strength.

Ink Penetration

Of these, ink penetration probably receives the most attention since it is of critical importance in most carton printing controlling, as it does, the amount of gloss that can be attained with gloss inks, the amount of ink required to maintain the specified depth of color, and the degree to which the ink film is anchored to the board surface. As a result of this importance, carton printers and board makers have been searching for some time for a method of testing which can be used to specify and control the ink penetration properties of board.

One of the more common types of such measurement might be classified as a "standing drop" test; that is, a drop of some liquid, of specified size, is dropped a specified distance onto the surface of the board, and the length of time it takes for the entire drop to soak into the board is measured. Opinion differs as to just what liquid should be used. Some use water; others object to the polar nature of water, preferring an oily material. Butyl carbitol is a popular choice since it is satisfactorily oily in nature and low enough in viscosity to make for conveniently short testing times. I, for one, object to butyl carbitol because of its low viscosity which allows it to penetrate the entire board during the test, whereas printing ink vehicles will never penetrate that deeply.

Some rather interesting work is now under way on "running drop" tests, in which a suitable drop of a suitable liquid is suitably dropped onto the board surface which is held at a suitable angle. The drop rolls down the surface, and the length of run is influenced by the rate at which the liquid is absorbed by the board. This has interesting possibilities, but again there is the question of what constitutes a suitable liquid.

Another approach is to place upon the board in question a uniform thin film of liquid and observe its rate of penetration. One such method is the "Vanceometer" test, in which a drop of mineral oil is spread by a steel roller on an inclined plane, after which the penetration is studied indirectly by measuring the gloss of the oil film. There is some disagreement as to what liquid is best, as well as how to interpret the gloss versus time curves.

A somewhat similar technique is involved in the use of Case testing ink, where a colored ink is smeared on the surface, then wiped off and the depth of color absorbed is judged. Another comparable technique is the use of gloss-testing inks on a proof press. It is difficult to obtain a numerical rating of penetration from this test, and accurate operation of a proof press must be considered as too time-consuming for routine use.

If all these approaches are not sufficient to make one wonder just how our little black box is going to measure ink penetration, let us consider also the interesting theory of W. H. Banks, of The Printing, Packaging, and Allied Trades Research Association, who points out that, strictly speaking, one cannot consider only the flow of ink vehicle through the paper,

but must also consider the flow of vehicle through the pigment particles of the ink (*1*).

Smoothness

We escape from this general confusion by passing on to the subject of smoothness. This quality is commonly defined as the levelness of the printing surface, and the usual methods of measurement fall into two categories. The first is the air-flow, or lateral porosity technique, in which is measured the rate of air flow between a plane surface and an annular surface of the sample being tested, or between two annular sample surfaces. This principle is used in the Bekk, Gurley, and Williams smoothness testers. It is subject to several major objections: (1) in the case of a thick material, such as board, the lateral porosity of the material itself may influence the results unduly; (2) such a tester cannot detect certain types of roughness, such as a wire mark; and (3) such a test might give equal ratings to samples that print quite differently (e.g., a surface having many small irregularities versus a surface having a few large irregularities).

The first two of these objections are avoided by the optical type of smoothness test, such as that devised by Chapman (*2*), in which the amount of surface in optical contact with a plane surface is measured under various pressures, but this technique is still subject to the third objection, although the Chapman instrument does permit visual observation of the surface under pressure, so that an experienced technician might be able to detect such differences. A further question raised is that optical contact with the printing form is not required for good printing.

No general correlation between printing quality and smoothness measured by the air-flow technique has been reported, although Carlsson (*3*) reported a correlation between usable halftone screen size and smoothness measured by the Bendtsen smoothness instrument, which is not well known in this country. The Chapman instrument is not in a commercial stage of development, so that not much is known of its usefulness as a practical measure of printing smoothness.

Compressibility

The compressibility of boxboard has a peculiar importance in the printing operation. In letterpress work, the printing form and the incompressible impression surface (i.e., the steel impression cylinder) are brought to within a fixed distance of each other, this distance being determined by the height of the form with reference to the bearers, and the depth the cylinder is undercut. The pressure developed during impression is that required to force a certain amount of compressible material—the cylinder packing and the sheet being printed—into this fixed space. In the printing of paper, the sheet being printed is but a small part of this compressible material, but a sheet of boxboard may well be the major portion of it. Thus, the compressibility of the board plays a large part in determining the conditions of the printing impression.

The variability of this property within a given sheet would seem to be of particular importance, since the presence of hard and soft areas could seriously affect the quality of the printing, not only through variations in pressure, but through variations in ink receptivity brought about by such local compressions.

Compressibility can be measured statically by determining the change in caliper brought about by increased pressure, or dynamically, by some such instrument as that devised by Bekk, in which is determined the size of the impression left by the slightly convex face of a pendulum bob. Neither method has won widespread acceptance, but a dynamic method with a rate of loading approaching that of actual press operation would seem to be desirable.

Surface Strength

The resistance of the printing surface to picking has always been a problem, particularly to those making coated papers and boards. The deficiencies of the wax pick tests have long been recognized, and some progress has been made in circumventing them, at least partially, by measuring the actual force required to make a pick (*4*). In recent years, several dynamic methods have been developed which more closely approach actual printing conditions. The National Printing Ink Research Institute is embarking on a project in which these testers will be evaluated, and further discussion of them may well be postponed until these results have been made known.

What is in the little black box?

The contents of our hypothetical little black box would provide the answers to some of the questions we have concerning the printability of boxboard.

We would like to know how best to measure the effect on printing of the affinity between board and ink. We would like to know what type of smoothness is necessary for good printing, and how to measure it. We would like to know how compressibility affects the quality of reproduction. We would like to know how best to measure the resistance to picking.

When we know the answers to these questions, we will know what to put inside our little black box, and all we will have to worry about then is how to make board that the little black box will give a big "OK."

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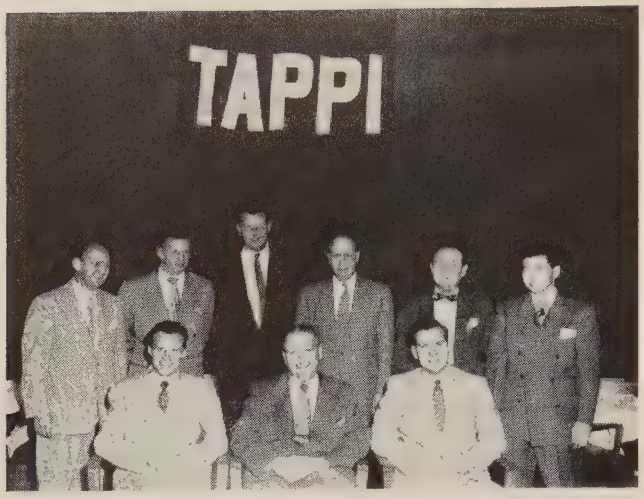
Chicago

On September 21, the Chicago section of the Technical Association of the Pulp and Paper Industry, held its first meeting of the 1953–54 season, which featured a presentation by representatives of the American Cyanamid Co., who outlined the company's promotion activities in developing a greater appreciation of the values of wet-strength papers. E. C. Berg, Ace Carton Corp., and chairman of the Chicago Section, presided at the meeting, and Charles Krebs, Atlas Boxmakers and program chairman, introduced the panel. Speakers on the program were: G. E. Fromm, Western regional manager, Paper Chemical Dept., American Cyanamid Co.; A. Asherman, Advertising Dept., American Cyanamid Co.; and Phillip Barber, Barber & Baar Associates.

The speakers brought out the fact that, while the industry had been using resins to impart wet strength to paper and paperboard for a number of years, the consumers as well as distributors of these products were not aware of the plus values they receive in wet-strength papers. American Cyanamid Co., which pioneered in the development of wet-strength papers through application of its Melostrength resins, has undertaken an educational program to bring about a greater appreciation of wet-strength papers, which they feel will increase the demand for such products.

In starting its program, which is being carried out with the help of Barber & Baar Associates, the company made a survey to find whether or not the consumers were aware of wet-strength papers. On finding that very little was known about wet-strength papers outside the technical and manufacturing group of the paper and board industry, they decided to undertake a promotional program.

This program was started with a press conference in June of this year in New York, where various types of wet-strength products were exhibited to a group of editors. This resulted



Officers and Committee Chairmen, Chicago Section, Front: J. Lyons, E. C. Berg, J. A. Johnson. Back Row: R. W. Porter, C. H. Krebs, R. S. Spain, C. S. Macnair, F. E. Hopkins, and K. Harita

in a number of feature articles in such magazines as *Life*, *Business Week*, and many others. Shown at the conference were such items as paper bathing suits, rain capes, paper pillowcases, duck decoys, military maps, and a variety of other products, all of which incorporate the company's Melostrength resins for imparting wet strength. Numerous tests demonstrated wet-strength papers in action and the versatility of their properties.

As a result of the company's promotion and advertising program, inquiries have been received from consumers, manufacturers of paper and paperboard products, distributors, and others, which indicate the wide interest in the diversified paper and paperboard products which utilize wet-strength properties.

Melostrength resin is made from the synthetic chemical compound, melamine, a complex compound derived from coal.

A. Asherman and G. E. Fromm of the American Cyanamid Co.

Used in paper and paperboard, it increases both dry and wet tensile strength and bursting strength. It controls linting and increases the pick resistance of printing paper and paperboard.

The resin, which is received by the mill as a dry powder, is mixed with a dilute solution of acid and the resulting mixture is added in small percentage to the pulp during the beating or mixing process. The resin helps bond the fibers together and, when the sheet comes off the machine, the resin is set and most of the strengthening action has taken place. An important quality of Melostrength resin is that, when added to the stock before beating or refining, it reduces the amount of beating necessary. Reduction in beating time produces a sheet of better dimensional stability with less tendency to curl.

Ohio

The October 8 meeting of Ohio TAPPI attracted 155 members and guests to an instructive program at the American Legion Hall in Middletown, Ohio.

Chairman John Clouse presented the officers of the Section for the 1953–54 season and introduced Ken Geohegan, a member of the Section and past national president of TAPPI.

George B. Gregg, treasurer of the Ohio Section, presented a financial report covering the previous year. Program Committee Chairman, William Aiken, announced the November 10 meeting which will be held in Middletown, Ohio, at the American Legion Hall and will be a joint meeting with the Superintendents Association. The meeting will be a panel duscussion on "Problems of Closing a White Water System." Dinner will be at 6:45 p.m. followed by the meeting. All members and guests are urged to return reservations promptly to the corresponding secretary.

Richard Kruger introduced the speakers of the evening who presented a panel discussion on recent developments in pulping. John N. McGovern, chemical engineer of the Forest Products Laboratory, discussed "Recent Developments in Semichemical Pulping" and Harold Bialkowsky, research director of the Pulp Div., Weyerhaeuser Timber Co., spoke on "Recent Developments in Sulphite and Sulphate Pulping."

Mr. McGovern began his talk on semichemical pulping by giving a brief history of the process. The following table gives the significant date in this history.

1874 Mitscherlich patent acid sulphite pulping
1880 Cross pulping with sodium sulphite
1921 Forest Products Laboratory experiments started
1925 Production of semichemical pulp from chestnut chips at Southern Extract Co.
1926 Application of Rue *et al.* for semichemical patent, granted 1932
1932 Patent Traquair and Rawling bleached semichemical pulp
1944 Southern Kraft Div., IPC, started first large installation for manufacture of paperboard by semichemical process
1947 First board produced with a Chemipulper continuous digester
1949 Consolidated Water Power & Paper Co. started bleached semichemical pulp plant
1953 Production bleached semichemical pulp with continuous digester by Champion Paper & Fiber Co.

Mr. McGovern then presented a table showing the number of board and paper mills using the semichemical process.

Year	Board mills		Paper mills		Total,
	No.	Tons/day	No.	Tons/day	tons/day
1925	1	10	...	...	10
1930	5	320	1	35	355
1940	7	415	1	50	465
1945	10	925	...	...	925
1947	12	1490	...	...	1490
1948	15	1955	3	80	2035
1953	22	3190	10	395	3585

The present tonnages of various grades of pulp were given by Mr. McGovern as follows:

Grade	Tonnage/year
Sulphate	9,560,000
Groundwood	2,970,000
Sulphite	2,650,000
Semichemical	1,230,000
Dissolving	720,000
Soda	470,000
Others	1,460,000

The location of semichemical mills was given as follows:

East		South Atlantic	
New Hampshire	1	North Carolina	2
New York	1	South Carolina	2
Pennsylvania	2	Virginia	1
Lake States		Appalachian	
Michigan	3	Tennessee	3
Minnesota	1	Virginia	3
Wisconsin	5	North Carolina	2
South		West	
Louisiana	2	California	1
Central States			
Ohio	2		

John McGovern then presented the table showing the annual consumption of wood in cords (hardwoods) by all processes:

Year	Amount	Year	Amount
1930	900,000	1945	2,400,000
1935	900,000	1950	3,200,000
1940	1,200,000	1952	3,700,000

The consumption by process in percentage was as follows:

Semichemical	26[a]
Soda	25
Sulphite	18
Groundwood	18
Sulphate	13

[a] Includes coarse fiber pulps.

Mr. McGovern pointed out that any pulping process can be used for semichemical pulping but that to date sodium sulphite has proved the most popular pulping agent. The cooking liquor is buffered with sodium carbonate or bicarbonate to give a pH slightly above neutral and hence the name, neutral sulphite semichemical, has been applied to this process. A table showing the requirements in chemical and power for semichemical pulping was presented.

	Board		Bleached pulp only	
	Wood basis	Pulp basis per AD ton	Wood basis	Pulp basis per AD ton
Sodium sulphite, %	8–14	...	15–20	...
Sodium bicarbonate, %	4–5	...	3–4	...
Sulphur, lb.	...	57	...	...
Soda ash, lb.	...	262	...	...
Fiberizing, hp.-days	...	12–78	...	10–12
Yield, %	70–80	...	65–72	...

There are three general pulping methods used in semichemical processing: (1) rotary digesters (spherical), (2) stationary digesters, and (3) continuous digesters. These methods of digestion are followed by fiberizing equipment of some sort. The cooking chemical for NSSC pulping can be purchased directly as sodium sulphite and sodium bicarbonate or can be made by sulphiting soda ash or caustic soda directly.

Two methods are generally used in bleaching semichemical pulp: (1) single stage bleaching similar to that employed for groundwood; chlorine demand as hypochlorite 10%; (2) multiple stage bleaching employing chlorination, caustic extraction, and hypochlorite bleaching. Brightnesses of semichemical pulps were given as follows: unbleached 40–55, single stage bleached 65–75, and fully bleached 75–85.

Semichemical pulp strength properties were given as follows (the following table gives these properties using a softwood sulphite as 100 and listing the semichemical pulp properties as a percentage of the sulphite):

Pulp	Burst	Tear	Fold	Sheet density
Softwood spruce sulphite (good grade)	100	100	100	100
Unbleached semichemical	50–90	90–120	10–50	60–80
Bleached semichemical	90–120	100–140	20–75	80–100

300/500 ml. Canadian standard freeness.

Pulps made by the semichemical process tend to be stiff and lack opacity. Semichemical pulps blend very well with other pulps and the major use in the future will probably be in blends with other pulps. Semichemical pulps also tend to be shivy but better fiberizing equipment is rapidly overcoming this difficulty. The major uses of semichemical pulp were listed as follows:

Unbleached	Bleached
Uses	
Corrugated board	Book, magazine (coated and uncoated)
Specialty board	Bond, writing
Newsprint	Glassine, greaseproof
Wrapping	Ford board
	Specialty boards
Possibilities	
Liner	Waxing, carbonizing
Toweling	Toweling
	Dissolving

There is presently no neutral sulphite semichemical pulp on the market. All of the pulp produced is used in an integrated operation. Some manufacturers are known to be interested in making market pulp. Some doubt exists about the ease of repulping of semichemical pulp but there is evidence also to the contrary. John McGovern stated that there probably will be no large quantity of semichemical market pulp for several years.

Harold Bialkowsky of the Pulp Div., Weyerhaeuser Timber Co., reviewed recent developments in the operations of Weyerhaeuser in sulphite and sulphate pulping on the West Coast.

Recent Developments in Sulphite and Sulphate Pulping

H. W. Bialkowsky

Members of the Ohio Section of TAPPI—your committee has generously invited me to come to this meeting at Middletown to review for you some of the developments in

H. W. Bialkowsky, Director of Research, Pulp Div., Weyerhaeuser Timber Co., Longview, Wash.

From left to right: Richard Kruger, who arranged for the October 8 meeting; Harold Bialkowsky, William Aiken, chairman of the Ohio Section program committee; John L. Clouse, chairman of the Ohio Section; and John N. McGovern

pulping and pulp production on the West Coast during recent years. While as papermakers you are primarily interested in pulp supply and pulp qualities, we believe it is necessary to know something of our sources of raw materials—our forests and trees—since these in turn are the main controlling factors in pulp capacity and fiber quality.

The forested areas of the Northwestern United States are located on the western slopes of the Cascade Mountain range in Washington and Oregon, and this is generally known as the Douglas-fir region. This region extends into British Columbia and into Alaska. The predominant wood species is Douglas-fir which is the major source of lumber raw material. Interspersed with the Douglas-fir there is a fair percentage of western hemlock, with lesser amounts of cedar, the true firs, and western spruce. As the forest industries developed up to the outbreak of World War II, Douglas-fir and cedar continued to be major species for lumber, while the so-called wood trees—hemlock, white fir, and spruce—were logged simultaneously with the Douglas-fir and consumed almost exclusively by sulphite pulping plants—both bleached and unbleached. About the time that Hitler invaded the low countries and the demand for pulp increased it became apparent that the existing supplies of pulpwood for sulphite pulping were about in balance, and even overtaxed by the existing pulp capacity if the region were to operate on a sustained yield basis. The expansion then came by better conservation of sulphite wood species, and the use of other species, predominantly Douglas-fir by the sulphate or kraft process. Since the Weyerhaeuser Timber Co. had extensive interests in managing and harvesting forest lands as tree farms, operated large sawmills and related forest products plants, along with pulp mills, I would like to seek your indulgence in allowing me to talk specifically about developments in our own company over the past 10 to 15 years.

The company's first pulping unit began operation in 1931 at Longview, Wash., making a high-grade bleached sulphite pulp from western hemlock. This plant received its raw material from the Mt. St. Helena tree farm which simultaneously supplied Douglas-fir and cedar logs to the company's Longview sawmills. In 1936, the Everett sulphite mill was built to use hemlock logs from the same logging operations supplying the company's Everett sawmills. This was the initial step in the utilization of all species from the forest land. The term "all species" does not mean that all the trees or all parts of the trees were brought in from the forest. The complete utilization of all trees, low grade logs together with milling and logging leftovers was then impractical because of uneconomical production and market conditions.

Since the boles of trees are long, round tapered cones, which are not necessarily perfectly straight, and since lumber is cut square and straight with a minimum of checks and cracks, there is bound to be considerable waste in milling operations. By definition, 1000 ft. of logs will produce 1000 ft. of lumber, but on the average only 40% of the log substance or weight is carried into the lumber footage. Bark accounts for 10%, slabs and short clears account for 28% by weight, and the balance is shavings and saw curf. Since 1000 ft. of logs weigh in excess of 10,000 lb., the salvageable sound wood for chips amounts to over 2800 lb. wet weight or the equivalent of over 700 lb. air-dry bleached pulp for every 1000 ft. of lumber produced. At our Longview operation alone, with a daily capacity of 1,000,000 ft., the saw mill leftovers could supply a potential pulp capacity of 350 tons per day. However, means had to be found to economically segregate this wood substance into clean, sound wood chips. Likewise, pulping and bleaching studies were necessary to evaluate and ultimately produce good pulp grades from this new wood species.

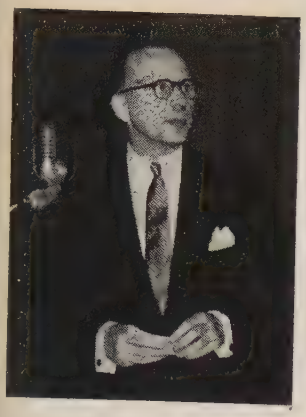
Probably one of the most significant and far-reaching factors affecting the supply of raw material for the West Coast pulp industry was the development of a successful hydraulic whole log barker by the Weyerhaeuser Timber Co. in 1942. This installation was made at the Everett sulphite mill in conjunction with a whole log chipper and resulted in savings of approximately 20%. This barker can handle logs up to 6 ft. in diameter and 25 ft. long, while the chipper was 172 in. in diameter and handled logs up to 45 in. in diameter. Since that time numerous modifications and improvements have been made, and there are now installations in nearly every West Coast pulp mill.

The hydraulic barker was also the key to the recovery of sound clean wood from the sawmills. The first installation of hydraulic barking for sawmill operation was made in our largest Longview unit. This barker is placed on the log haul, just before the head-rig and can handle Douglas-fir logs up to 48 ft. in length and 9 ft. in diameter. By an elaborate system of conveyors, the slabs and edgings and short clears are hauled to the sawmill chippers and, after screening, the chips are conveyed to the pulp mill chip silos or sold to neighboring mills. Peeler cores and checked green veneer pieces are routed to special chippers and the recovered chips are sent to the pulp mill. Similar barker and chipper installations have been made in the company's sawmills at Springfield, Everett, Snoqualmie Falls, and White River. Most of the other larger sawmills in the region are following this practice and it is now quite common to see large covered trucks hauling chips on the highway, special chip cars on the rails, and large barges on the waterways.

Hydraulic barks had an effect on better logging practices generally known as prelogging and thinning and also relogging. In prelogging, the smaller trees are taken out first with lighter equipment. Relogging entails the collection of smaller logs with lighter equipment after the heavy equipment has moved on. These logs are 20 to 40 ft. long and from 20 to 8 in. in diameter and they are barked with smaller barkers such as the Allis-Chalmers or ring types.

With the exception of the original barker and chipper at Everett which was under construction at the time of the attack on Pearl Harbor, these developments have occurred since the Japanese surrender. Such then is the origin and nature of our raw material, which ties in with the company's policies of whole crop utilization and sustained yield forest management.

I believe most of you are quite familiar with the properties of West Coast hemlock sulphite pulp, since large tonnages have been on the market over the past 20 years. There have not been too many changes in sulphite pulping in recent years, except for modifications of bases—that is the use of the more soluble bases such as sodium, ammonia, and magnesium in place of calcium. There is no doubt that the more soluble bases have certain advantages over calcium in the older cold and low acid strength systems. However, the advantages are sharply narrowed down when compared with hot acid and high-strength acid installation. The use of these bases is justified when associated with complete heat and chemical recovery. At Longview we have installed the magnesia-base system for complete chemical and heat recovery, and the equipment and operation are quite similar to modern kraft operations. This installation eliminated a heavy pollution



J. N. McGovern, Forest Products Laboratory

H. W. Bialkowsky, Weyerhaeuser Timber Co.

load and the steam and power generated by burning the sulphite liquor organic solids were needed to replace that which formerly would have been generated by burning sawmill "leftovers." A second MgO unit is now under construction in the new plant being built in Ketchikan, Alaska, by the Puget Sound Pulp & Timber Co.

The sulphite bleach plants consist of three-stage bleaching —chlorination, caustic extraction, and moderate final hypochlorite. Screen rooms are provided both before and after the bleach plants, and we have recently installed Centri• Cleaners for minimizing dirt. All of our market grades of pulp are dried on Minton vacuum driers. Our sulphite grades consist of standard sulphite, nitration or soft alpha, paper alpha grades, and viscose alphas.

We introduced bleached Douglas-fir kraft as a market pulp in 1948. The properties of this pulp are quite different from other grades of kraft, due primarily to the characteristics of this wood species. This species is a fast growing tree and it grows to very large dimensions. Older trees reach heights of over 200 ft. with diameters over 9 ft. The yearly growing season is quite long and there is a pronounced difference between the springwood and summerwood fibers. Both fibers are long, but the springwood has a large diameter with thin walls, whereas the summerwood, has a smaller diameter with relative thick walls—i. e., a fine lumen. All woods, of course, show this characteristic, but this feature is exaggerated in this species. The thin-walled summerwood fibers hydrate like other conifers, but the summerwood fibers are less pliable and seem to be cut rather than hydrated. The resulting pulp refines more easily than krafts from other species and it also "forms up" remarkably well for a long fiber. Fir pulp has about the highest tear of all conifers.

Another unique feature of Douglas-fir wood is that the hemicelluloses are low to begin with, and on pulping, the hemicelluloses are readily removed. The resulting pulp without any purification has an alpha higher than most other conifers—around 90 as compared with 88 for western hemlock and 86 for eastern spruce. We believe this is associated with the bursting and fold strengths of fir falling between strong sulphites and the highest strength krafts. In general, Douglas-fir has a higher bulk for the same degree of beating than hemlock and spruce sulphite.

Our pulping units are typical of present-day design—vertical stationary digesters with indirect heating and forced circulation—four-stage washers—multiple-effect evaporators and direct contact evaporators—and Babcock and Wilcox or Combustion Engineering recovery furnaces. On recent installations we are using high density storage and Lindblatt screens ahead of the bleach plant and ahead of the drying machines.

Our bleaching sequences are as follows: direct chlorination, caustic neutralization or extraction, alkaline hypochlorite, caustic extraction, one or two final hypochlorite stages with a final acid wash. Our first unit was all batch operation, the second was all continuous, and the most recent unit is a combination continuous and batch.

We are currently marketing two grades of kraft pulp, one a regular paper-grade kraft for general utility purposes and a soft kraft for sanitary purposes and special paper requirements. Both are bleached to a brightness of 86 G.E.

During the past 6 years we have expanded our production facilities by building four kraft units, two at Longview, one at Springfield, Oreg., and one at Everett, Wash., which just started operation in recent weeks. Our productive capacity has increased from 170,000 tons in 1947 to about 550,000 tons annually. This has been accomplished by improved uses of our forest crop with the maintenance of sustained forest yield. We also believe that, in the future, further advances will be made to enhance this tonnage, and continued technical study will improve our various pulp grades.

Delaware Valley

One hundred ten members and guests were present at the dinner meeting at the Hercules Country Club, Wilmington, Del. During the afternoon an extensive conducted tour of the Hercules Experimental Station took place.

Chairman Frank Lovegren opened the meeting, thanking the Hercules Powder Co. for the use of their club facilities, and the tour of the Experimental Station. He announced that E. M. Glauner (Downingtown Mfg. Co.) is the new Editor of the Delaware Valley Section, *TAPPI Newsletter*, and requested that all news items be sent to him.

Mr. Lovegren paid a tribure to Harold Brill (Du Pont) retiring chairman, and presented him with a pen set on behalf of the group.

The meeting was turned over to John Dieffenderfer (Hercules Powder Co.) who introduced R. Rockwell, General Manager of the Paper Chemicals Div., Hercules Powder Co. Mr. Rockwell welcomed the section on behalf of Hercules.

W. H. Roberson (Hercules Powder Co.) acted as moderator of the panel on "Analytical Tools Available to the Paper Industry." He reviewed the general background, pointing out that these tools were available first, for research problems, second, for development and production problems, and third, for operating problems in industry. The panel (all from Hercules Experimental Station) described new instruments and their uses in solving practical problems. Their remarks are summarized below.

Chemical Analysis Using Infrared and Ultraviolet Radiation

W. C. Kenyon

In the spectral regions adjacent to visible light, a very large number of compounds absorb radiation, and usually in a characteristic pattern which can serve for identification as accurately as a fingerprint.

To examine a material in the ultraviolet region, the light source is an electric discharge in hydrogen gas. A quartz prism separates the wavelengths, and a photoelectric cell serves as detector. Percentage transmission may be plotted against each individual component of the radiation, that is, each narrow band of wavelength. Correlation of these spectrograms has shown that compounds which contain conjugated double bonds will show absorption in this spectral region. For example, the abietic-type acids in rosin show very pronounced absorption in the ultraviolet region.

We have on file the plots—transmission against wavelength —for about 1000 chemical compounds. If an unknown is submitted for identification, we first obtain its plot (spectrum) and compare this with our reference file. If two or more com-

W. E. Fox, W. C. Kenyon, W. J. Mackwood, Jr., C. W. Hock, W. H. Roberson, and E. J. Barber of the Hercules Powder Co.

pounds are present, it is possible to match the unknown with two reference patterns added together according to the proper weighting factors.

To examine samples in the infrared region, quite different equipment is used. An almost white-hot bar of ceramic material is used as a radiation source; a prism made from a very large rock salt crystal will separate the components of radiation; and a delicate thermocouple is the detector. By reference to known patterns, absorption in a particular portion of the infrared region indicates what molecular structures are present in a material. We can quickly detect the existence of such molecular groupings as carbon-hydrogen, ether, hydroxyl, carbonyl, amide, and amine. Actually, almost every liquid or gas absorbs in this region—except diatomic molecules and rare gases. We have on hand about 6000 different reference spectra. The infrared absorption curve of a compound is highly selective and can be used for both identification and quantitative estimation.

A frequent use of ultraviolet and infrared absorption spectra is the identification of deposits in paper mills. Pitch, for example, can be compared with extracts of pulp and with components of size. It can more easily be eliminated or controlled after its source has been determined.

The Use of Instron Tensile Instrument for the Study of the Stress-Strain Properties of Paper

W. Markwood

The Instron tensile instrument is essentially a tensile testing machine. Its advantages over other strictly mechanical types are its tremendous ranges of load, stretch, speed, sensitivity, and magnifying power. Minute changes in the stress-strain characteristics of systems can be detected. The components of the machine are a highly versatile weighing system, a magnifying recorder, a speed control, a cycling system, and an integrating device. All of these units are electronically controlled. The Instron is essentially a research tool, but in certain instances its speed and semiautomatic operation make it suitable for control use.

The instrument is especially useful for studying the stretching, bending, breaking, relaxing, and tearing behavior of paper, cloth, yarn, rubber, adhesives, and similar physical systems. The actual physical properties that can be accurately determined are tensile strength, elongation, moduli of elasticity, compressibility, flexibility, stress relaxation, hysteresis, tear resistance, and adhesion. Measurement of changes in these physical properties may be utilized to study the influences of sizes, coatings, and resins on the mechanical properties of such widely different grades of paper as tissue or folding boxboard. It has been shown that certain dry papers fatigue when lightly stretched, but wet papers do not. The elongation of dry paper may not be affected by resin, whereas wet paper may be markedly altered.

Defining the Surface Smoothness of Paper with the Brush Surface Analyzer

E. J. Barber

Surface smoothness is recognized as an important property of paper and paperboard intended for printing and converting. Some information has been obtained on the measurement and classification of smoothness, and further information is needed in order to establish correlation with printing characteristics. A study of paper smoothness has revealed that the size and shape of surface irregularities are of greater significance than "average" or "composite" roughness. Some observed effects of smoothness on printing can be accounted for, and some printing qualities can be predicted.

An "average" or "composite" measure of surface irregularities does not give an adequate definition of smoothness. Surface irregularities can be classified into groups according to size and shape, and these groups are related to printing characteristics. In the printing nip narrow high peaks in the surface penetrate the ink film to such a depth they emerge with a very thin covering of ink. The result is a light spot in an area which should be a solid color. Similarly, a deep narrow valley may be devoid of ink. Broad high peaks print satisfactorily because they do not penetrate the ink film deeply. Their breadth results in a wider distribution of the excess nip pressure. The frequency of narrow high peaks has been successfully correlated with printing quality. These conclusions are based upon measurements made with a Brush surface analyzer.

The Brush analyzer consists of a diamond stylus or probe attached to a crystal, an amplifier, and a device which records a magnified profile of the paper surface on a moving chart. The instrument is, therefore, similar to a phonograph record player except that the surface irregularities are translated into an expanded profile tracing instead of sound.

X-Ray Diffraction as Applied to Papermaking Problems

W. E. Fox

When a crystalline substance is irradiated with x-rays, a diffraction pattern is produced. This pattern characterizes the chemical compound or compounds comprising the sample. This diffraction phenomenon can be demonstrated in principle with visible light; but when x-rays are employed, photographic film or a Geiger counter must be used to detect and record the diffracted rays. Because of the short wavelength of x-rays, they are diffracted by the repeating crystalline lattice and produce a distinctive complex diffraction pattern unique for each lattice structure. These diffraction patterns for several thousand crystalline structures have been collected and indexed by the American Society for Testing Materials and can be used to identify unknown crystalline materials. One of the advantages of the x-ray method is the specific identification of the compound being tested even to its state of hydration or allotropic form. Another advantage is the small sample required and the nondestructive nature of the test method. It is limited, however, to crystalline substances for which there is a reference pattern.

Our laboratories have used x-ray diffraction in solving papermaking problems involving the identification of coatings on paper, the identification of spots in paper, water analysis,

the examination of boiler scales, and the identification of miscellaneous deposits and sludges.

Microscopical Studies of Rosin Sizing

Charles W. Hock

THE light microscope is an extremely useful tool for both research and control in the pulp and paper industry. There are, however, instances where the light microscope gives only meager and insufficient information. Visual studies of rosin sizing are a case in point. In order to obtain new information about this old problem, thereby giving a better answer to "How and in what form is rosin size distributed on the surfaces of fibers in a sheet of sized paper?" the electron microscope, with its higher resolving power, was utilized.

Size precipitates, white water samples, and single fibers from sized sheets were examined. Direct electron microscopical examination of size precipitates and of white waters revealed that the particles of rosin size were more or less round, that they averaged about a thousand angstroms in diameter, and that they occurred either singly or in groups. Because single pulp fibers are too thick to be used directly in the electron instrument, the examination of their surfaces was accomplished by means of surface replication, wherein impressions of single fibers in thin films of plastic are used as specimens.

The replication of objects as small as single wood pulp fibers is tedious. Fortunately, autoradiography (a technique wherein the location of radioactive material is revealed by allowing the specimen to take its own picture) of single fibers from paper sized with radioactive rosin size showed that all the fibers were sized equally. This knowledge of fiber-to-fiber uniformity brought within practical limits the number of single fibers requiring replication. The electron micrographs revealed that the sized fibers had comparatively rough surfaces because they were irregularly covered with size particles similar to those seen previously in size precipitate and in white water. On the other hand, micrographs of fibers from unsized water-leaf sheets were smooth, except for the normal fibrillate surface pattern.

These observations support the often expressed opinion—not hitherto confirmed by direct visual observation—that rosin size is not present as smooth surface-covering films but rather in the form of discrete particles.

Q. FRANK LOVEGREN (P. H. Glatfelter Co.): Can presence of amorphous material in a coating affect identification of crystalline material?

A. W. E. FOX: No. It acts only to dilute the pattern.

Q. P. E. NETHERCUT (Scott Paper Co.): How accurate are quantitative x-ray analyses of crystalline material?

A. MR. FOX: Not too accurate. Plus or minus 10% perhaps.

Q. HAROLD BRILL (Du Pont): Can you determine types of pulps by x-ray?

A. MR. FOX: No. Only cases where a definite crystalline lattice rearrangement takes place can be identified, such as viscose for example.

Q. W. P. DOHNE (Dixie Cup Co.): What has been learned with the Instron Tensile Tester as regards formation and its effects?

A. W. MARKWOOD: Very little, except in a general way; poor formation causes lowered strength properties.

Q. C. R. CALKINS (Riegel Paper Corp.): Have individual wood pulp fibers been tested on the Instron?

A. MR. MARKWOOD: No, not to my knowledge. It would be possible with proper mount.

Q. Can the adhesive in coatings be identified by infrared techniques?

A. W. C. KENYON: Yes, under certain conditions; the material must possess different structure. Latex or protein as distinguished from starch would be straightforward.

Q. C. M. CONNER (W. C. Hamilton): Could a mixture of adhesives be identified?

A. MR. KENYON: Latex, starch, and casein could be identified, but not starch and cellulosic materials.

Q. JOHN WEIDNER (Container Corp.): At what point do peaks cause trouble in printing? Has this been defined?

A. E. J. BARBER: This depends on printing operation and type in letterpress with a 0.1 to 0.2-mil ink film on plate before printing, peaks of 0.07 mil would begin to cause trouble.

C. R. CALKINS, *Secretary*

EMPLOYMENT SERVICE

POSITIONS WANTED

E255-53. Technical Executive. Broad background of managerial positions in manufacturing, converting, and sales with larger groundwood, book, and newsprint mills, knows way around paper industry, including merchant, direct, and converter sales. Well-known and recognized in printing, printing ink, publishing industries. Interested in administrative, purchasing, manufacturing, quality control, or sales service. Technical education, age 41, personable.

POSITIONS OPEN

P323-53. Quality Control Supervisor. To supervise installation of quality control program in midwestern corrugated box and folding carton plant. Prefer man experienced in quality control and production.

P338-53. Graduate Chemical Engineer, capable of organizing and supervising control of quality and operations in bleached sulphite mill in Eastern Canada. Large expansion program planned.

P341-53. Experienced supervisor of research to direct work of small modern research laboratory in large integrated midwest mill manufacturing fine papers. Interest and ability in conducting research on pulping, new products development, lacquers and adhesives is requisite. Please submit complete résumé, photograph, and salary requirements.

P342-53. Chemist with B.S. degree. Opportunity in packaging division of food company laboratory located in New York City. One year's experience in packaging desirable. Salary open. State age, experience, education, and salary expected.

PAPER CHEMICALS SALESMEN

Several positions with good advancement potential available in large national chemical manufacturing organization, involving sale and service of chemicals to the paper manufacturers. Graduate chemists or chemical engineers, age 25 – 30 preferred, but not essential. Several years' technical experience in paper industry required. Please submit complete résumé and indicate salary desired. Our sales staff has been informed. Write to TAPPI, P329-53, Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

SALES SERVICE

Well-established Chicago animal by-product manufacturer desires man 25–35 for glue sales and service. Must have chemistry or engineering degree. Previous paper mill technical or sales experience preferred. Excellent opportunity. Salary and expenses. Must have own car. Mid-west and East territory. Write complete details, including salary requirements and photograph. Respond to Tappi, P 339-53, Technical Association of the Pulp and Paper Industry, 155 East 44th St. New York 17, N. Y.

CHEMISTS AND ENGINEERS

P340-53. Because of recent and planned expansion into fields of hardwood pulping and byproducts, we have openings for chemists and chemical engineers in the following groups.

Pilot plant and mill scale development. Experience in sulphate or neutral sulphite semichemical pulping essential.

Laboratory and pilot plant research. Experience not essential.

Please give complete résumé of qualifications and experience with initial salary requirements. Enclose recent photo. Write to Director of Research, The Crossett Companies, Crossett, Arkansas.

MISCELLANEOUS

A-4. Wanted: Bound copies of Technical Association Papers of the following years—1925, 1926, 1930, 1933, 1936, 1938, 1939, 1940, 1941, 1945, and 1947. Reply to Technical Association of the Pulp and Paper Industry, 155 E. 44th St., New York 17, N. Y.

REPORTS AND DISCUSSIONS

Presented at the National and Regional Conferences

Straw Specifications and Grading

The 1952 Fall meeting of the Fibrous Agricultural Residues Committee of the Technical Association of the Pulp and Paper Industry which was held at the Northern Regional Research Laboratory, Peoria, Ill., Oct. 27–28, 1952 was attended by more than 70 mill men, chemists, engineers, and equipment manufacturers, including a delegation of 12 representatives of the Netherlands straw and paperboard industries, who were visiting this country under the auspices of the Mutual Security Agency. This group was led by J. Koski, project manager, Productivity and Technical Assistance Div., Mutual Security Agency, Washington, D. C., and had J. N. Trenite of the Mutual Security Agency as interpreter. The Netherlands delegation consisted of four executives, four technical men, two operators, and two union officials who came to this country to study production and labor relations of the American strawboard and paper industries.

Monday, October 27

The meeting was opened by the committee chairman, S. I. Aronovsky of the Northern Laboratory, with the usual self-introductions. R. T. Milner, director of the Laboratory, then welcomed the group to the Laboratory, pointing out that this was the fifth meeting of this group at Peoria. He discussed briefly the scope of work at the Northern Laboratory, with particular attention to the fields of work other than agricultural residues and pulp and paper. He voiced the hope that this group would return to the Laboratory again at an early date.

Mr. Milner was followed by the guest speaker of this meeting, W. H. Hosterman, assistant chief, Standards Research and Testing Div., Production and Marketing Administration, U.S.D.A., Washington, D. C., who spoke on "Straw and Hay Standards."

The straw standards were made effective Jan. 2, 1933, after study of the various factors which should be incorporated into such standards. These standards were set up primarily at the request of the U. S. Army since at that time considerable quantities of straw were needed for bedding. The standards are, therefore, probably better adapted to straw for use as bedding than for straw for use in industrial processing.

The standards were developed to apply to the type of straw that was common at that time, namely, straw that was harvested with the grain binder and threshed with the stationary thresher. Since that time the methods of harvesting grain have changed so that today most of the grain is harvested with the combine which has changed the character of the straw which is now available.

U. S. Standards for Straw

The standards for straw apply to straw from grain plants—wheat, oat, barley, rye, and rice straw are defined as the stems, leaves, and chaff of these crops which remain after threshing and may include not more than 10% of timothy and other grasses which are not coarse and woody.

Chaff shall be the shattered glumes and pieces of straw not over 4 in. in length. Chaff was defined to include short pieces of straw because this material was not available for reuse in maintaining a satisfactory bed in the bedding for animals. The grades were divided into three grades: U. S. No. 1, U. S. No. 2, and U. S. sample grade. The grading factors in the numerical grades were color and chaff. Straw which does not meet the requirements for the numerical grades or which contained more than 75% of chaff or was unsound is sample grade.

Special grades for chaffy straw containing over 35% of chaff and long and straight rye straw are also provided.

Inspection

The inspection of straw is carried out under the Permissive Inspection Act. Inspections are made on request by inspectors who are employees of a state Department of Agriculture or a local trade organization such as a Board of Trade or Chamber of Commerce and by employees of the United States Department of Agriculture after receiving training in the proper application of the standards. All inspectors are licensed or authorized to inspect straw by the U. S. Department of Agriculture.

Following Mr. Hosterman's address, the chairman read the questions sent in as a basis for this round-table discussion, and invited comments:

1. "Is it possible to control railroad cars to limit deliveries so as not to exceed unloading capacity at the mill?"

H. C. Sackett, Alton Box Board Co., Alton, Ill.: The matter of controlling delivery of railroad cars stems from the fact that you must control your shipment first. After all, the minute an agent for the railroad signs the bill of lading, it is in the hands of the railroads and there isn't anything that they can do about it, unless they want to violate the Interstate Commerce Commission laws, except deliver the cars as quickly as possible. It would be my opinion that you must control your origin date rather than your delivery date; if you have shipments moving over four to seven different railroads, naturally there isn't anything you can do about controlling them after they leave the point of origin.

R. D. Shiflet, Weston Paper & Manufacturing Co., Terre Haute, Ind.: I do not think I can add anything. You have to control the point of shipment and your originating date.

Mr. Sackett: We have the same difficulty in controlling our delivery of straw by truck. We schedule our deliveries by truck from our suppliers, and even then we do get into some difficulty, especially when the season is brand new. After 3 or 4 weeks we get the program in the groove.

C. G. Krancher, Ball Brothers Co., Noblesville, Ind.: Have the previous speakers used bunching? Oftentimes we get seven or eight cars delivered in one day. We have an agreement with the railroad to have those cars delivered in the order in which they were shipped rather than all at once If one were shipping seven cars from Minnesota or Dakota, for example one each day and all delivered one day, one could perhaps invoke a bunching agreement and obtain additional time to unload.

G. A. Dunlop, Ohio Straw Co., Coshocton, Ohio: I agree with Harry (Sackett) that you have to control shipments at point of origin. It is pretty hard to prove bunching if you have five or six different roads all converging on one junction point.

V. L. Hawkes, Container Corp. of America, Circleville, Ohio: Nothing further to add . . . control at point of origin.

V. E. Bush, Hinde & Dauch Paper Co., Fort Madison, Iowa: Control of railroad cars was one serious problem for us

this year. In one day in July we received 92 truckloads and 117 carloads! We got into this jam because in recent years we have been able to take every bale of straw offered and even took straw from Canada last year. Last year our demurrage bill was $25 so it wasn't coming too fast. In view of the fact that our company has always taken everything shipped or delivered by truck, many people did the same thing this year, not considering that there was a tremendous crop; we received straw from people we had never heard of. I think control at the source is the right thing, but if people whom you never contacted load up cars and ship, I do not know how you can control them.

MR. SACKETT: When we see that happening, we immediately ask the carriers to put on an embargo—it takes 48 hr. to become effective. The carriers immediately request the railway association to put on an embargo and it can be lifted at 48 hr. notice at our request. That is the only way we can control this unauthorized shipping.

MR. ARONOVSKY: Mr. Lyon, what about the status of your educational program?

H. LYON, Weston Paper & Manufacturing Co., Terre Haute, Ind.: Our company has taken no cars this year or the last couple of years. We unloaded 320 truckloads of straw on some days during daylight hours this past year, and we have used the embargo to stop car straw shipments in the past.

2. "It has been reported that some mills unload as much as 7000 tons in 1 week. What kind of equipment is used, how much labor is involved, and is unloading carried on for 24 hr. a day?"

MR. LYON: We unloaded as much as 7000 tons in 1 week, over 300 truckloads on some days. Some truck drivers wait for 24 hr. or even more, with a 3-mile lineup. They did not appear to mind the waiting period, in fact, they seemed to enjoy it.

C. H. R. JOHNSON, Consolidated Paper Co., Monroe, Mich.: How many total tons did you ship?

MR. LYON: About 32,000 tons, by the 10th of August, 1952, by truck only.

MR. BUSH: I would like to know how to unload cars efficiently.

MR. SACKETT: Tell us how you do it.

MR. BUSH: We use tractors and trailers. We employ five men in a car, one man driving the tractor, five more on the stacks, and two men at the base of conveyor. As the trailers come, two fellows on the conveyor unload, five men stack, five load while they do that. Next year we have an idea to use four trailers with each tractor. Instead of five men in one car, we will have six men in two cars loading two trailers at one time. When the tractor returns, it will find a loaded trailer. We will have one trailer waiting at each conveyor all the time and the conveyor running all the time. I wonder if other methods might be better?

MR. SACKETT: If you want to change around your receiving setup, then I think you can improve that materially. I think it would eventually save you the cost. Build ricks in between sets of railroad tracks, handle straw out of the car onto the conveyor to the rick.

MR. BUSH: We did that in Indiana, but in Fort Madison the cost would be prohibitive.

MR. LYON: Mr. Bush, how much more would it cost to unload cars than trucks?

MR. BUSH: About a dollar a ton more to unload a car than a truck.

3. "What is the total cost to the shipper for stockpiling straw in the farm area?"

MR. LYON: I do not think any farmer can stockpile for less than 4 or 5 cents a bale—$1.25 or $1.50 per ton.

G. ADAIR, Alton Box Board Co., Alton, Ill.: I do not think you can definitely put a figure down for that. Certain specific shippers have definite costs; the farmer-operator has a separate cost. If you are close to an industrial area, labor costs are greater. The farmer with two or three boys—his costs are down. You can only arrive at an average cost. I would say, at a rough guess, about $8.00 per ton. We have done considerable stockpiling in the field. We make an advance to the farmer at the rate of $2.00 per ton, the balance he has remains as a hauling cost.

MR. DUNLOP: In the last couple of years we have been stockpiling straw, but not on the farm. In most cases we have leased some ground and attempted to have straw brought to a central point from areas of 10 to 15 miles around. We have found the cost to be $1.50 to $2.00 per ton and we pay the labor.

MR. ARONOVSKY: What does the farmer realize on straw per ton before anything is done to it?

MR. ADAIR: Most fellows are paying around 10 cents a bale or $3.00 a ton.

MR. BUSH: That is about the way some of our shippers report. We had several cases where they paid our shippers to take the straw off the ground. For instance, a Nebraska farmer offered $1500 to have the straw removed from the ground and baled—2000 acres at 75 cents per acre. He said that 5 or 6 in. of stubble resulted in producing better yields of wheat.

4. "What is the value per ton of stockpiled straw used as a basis for insurance?"

MR. BUSH: I sent in the question and I was asked by our company. We aim to carry insurance so that if a pile burns, the shipper will not lose on it. We are trying to find the average cost. We advance $9.00 a ton on stockpiled straw, and in checking with some of our shippers to get this information the company got an answer as high as $9.00. $8.67 was the highest cost figure submitted. Last week one pile burned and he said that after it burned he had $11 in it. (He said he did not know whether one could carry any more on stockpiled straw than what he invested.) If too high, he would have some profit, too low, some loss. That is the first fire we have had.

MR. ADAIR: We have had four fires already this year. We made the farmer an actual advance on the basis of over-all price less his hauling. He got more than $10 per ton.

MR. ARONOVSKY: The rick on the farm is yours—it does not belong to the farmer?

MR. ADAIR: That is right. He definitely signs an agreement, that it is our straw.

MR. BUSH: If you include shippers' profit plus cost on that type of stack, aren't you encouraging him to burn it up rather than to haul it?

MR. ADAIR: You have to know the shippers. I do not think we are.

MR. ARONOVKSY: Is there a profit on hauling?

MR. ADAIR: There is; 80 to 90% of our folks do their own hauling. They carry 75 tons and less themselves, but employ a common carrier for more than 75 tons.

MR. LYON: We usually advance about 35 cents a bale—$10 to $11 a ton. If it burns, we forget about it. We do not carry insurance.

MR. DUNLOP: This year our company had storage straw insured, and the insurance company laid down laws as to how the straw would be piled: 150 ft. clear space in all directions. The maximum value is $3000 a rick; we can go as high as we like provided we do not exceed that amount.

5. "How can spontaneous combustion fires in ricks of baled straw be eliminated?"

MR. ARONOVSKY: At the first meeting we held at this Laboratory, I believe the consensus was that there was little or no trouble from spontaneous combustion.

MR. BUSH: I read that report yesterday. My company had two stack fires this year, and there was definite proof of spontaneous combustion. The location was north of Shaeffer's pen factory. One night, just after midnight, an employee smelled smoke from the air conditioning vent; vapor was seen rising off the straw pile. Vapor is caused when the straw be-

comes extremely hot during the day, then cools off at night. Firemen were certain there was no fire, until flames burst forth. I was certain that the fire started inside. One night there were similar circumstances, but fire did not actually break out, although one could not hold his hand on the stack because of the extreme heat. The other fire occurred after a rain, when we thought conditions were good. The type of wheat straw involved was no. 1, dry.

E. C. Lathrop, Northern Laboratory, Peoria, Ill.: The cause of such fires is generally associated with moisture. If you have wet material, it starts to ferment and this fermentation is a reaction that produces heat. Since this reaction is taking place in a well-insulated mass of material, heat cannot get away from the mass and the temperature keeps rising to the ignition point. There has been a big problem with hay and drying of hay. You might have a situation where green weeds are included in the bales. Another thing that might happen is to have a rain during the stacking period, and complete the stack with a large number of wet bales inside. With bagasse you have a different situation—you are starting with a wet material. There is 50% moisture content in bagasse. To solve the problem, we arranged ventilation of the bales. In straw you do not do any ventilating, but it can be arranged. In connection with storing of bagasse, we had a few fires during my time with Celotex; most of them we thought were due to careless smokers. A great deal of moisture came off the piles of baled bagasse during the storage period. Before satisfactory methods were worked out, there had been a number of disastrous attempts to store baled sugarcane bagasse in Louisiana. My suggestion would be, if you are having trouble with fires, that you ought to do something about increasing ventilation in the stacks. (Mr. Lathrop then drew a diagram on the blackboard illustrating side ventilation.)

Mr. Aronovsky: It is my understanding that fires in the western forest areas are usually caused by vehicles, men, and sparks rather than by the wood itself. I wonder whether all the fires Mr. Bush mentioned had occurred after 8 p.m. and none during the day.

Mr. Bush: That is when they were first discovered. They could have smoldered some time.

Mr. Aronovsky: It seems so uncanny to have three stacks start at night in the middle of the pile.

Mr. Lathrop: The temperature of the stacks can be determined by means of a thermocouple; this would involve a certain amount of expense and an instrumentation problem. You might also start thinking about ventilation.

F. B. Grunwald, Consolidated Paper Co., Monroe, Mich.: Our company had used pipes—old boiler tubes or pipe could be used. We did not go through the top—we came out on the sides, as Mr. Lathrop suggested.

Mr. Sackett: I have found the most effective cure for fires was the offering of a $500 reward for information leading to the conviction of the originator of the fires. The fires stopped almost overnight.

D. G. Landweer, Scholtens Board and Paper Mills, Groningen, Netherlands: We have a lot of fires owing to liming. In Holland we have practically no cases of spontaneous combustion; our straw is much cleaner.

Mr. Hosterman: I want to ask about the third stack that did not burn; was that opened? I wonder about the condition of that stack; it would be interesting to see whether it had had very high temperature—that would show up in the appearance and condition of the straw.

Mr. Bush: We did not observe that.

Mr. Hosterman: Mr. Roethe, assistant director of the Northern Regional Research Laboratory, and I made an observation in Maryland about a spontaneous combustion fire. The farmer had placed chopped hay in a barn which was quite tight. Detecting a strong odor of heat during the day, the farmer had asked that the doors be kept shut. In the afternoon an employee noticed the odor and decided to ventilate. Almost immediately it burst into flames and the roof of the barn burned off, but the hay did not burn up. Mr. Roethe and I found temperatures of 165 to 170°F. The hay was removed so the barn could be rebuilt. Whenever the hot spots in the hay were opened to the air, those spots immediately began to burn. The critical temperatures are 165 to 200°. In stacking straw bales on the edge rather than flat there would be less chance for that material to lay so close it would retain the heat. Our agency has been continuously recommending that farmers storing hay in bales from the windrow, pile the hay in the barn on edge rather than wire side to wire side. I do not know of any instances of spontaneous combustion in dry hay. In every case it was due to the fact that there was excess moisture at the time it was stored.

6. "What is being done about covering wheat straw ricks either in mill storage or on the farm? What methods are used to preserve exposed straw ricks? With regard to the use of borax, how much of this material is required per rick of 50 by 65 ft. top surface? What is the proportion of the amount of borax spread on the top tiers of the rick?"

Mr. Adair: Our company had tried practically every tying, including burlap and a wet-strength paper laminated with asphalt, but that did not work too well. It is difficult to find something which will hold up on the stack. Polyethylene was tried. We are now going to use metal covers; these were not available during World War II. A metal frame covers one side of the stack with a small gable 18 in. high. The cost is about $17 to $19 apiece. I do not know how long they would last, but estimated a maximum of 8 yr. or a minimum of 3 yr.

Mr. Aronovsky: How do you protect it? Do you paint the metal cover?

Mr. Adair: Yes, it is galvanized. A no. 9 galvanized wire will be used to hold the top down on the stack. There would be a small opening at the ridge.

Mr. Lathrop: We solved this problem at Celotex, using large metal shingles. We had to dip the galvanized iron shingles in asphalt because acetic acid condensation on them was encountered. It had been estimated that the life of the shingles would be 3 yr., but they lasted 15 yr. and some are probably still in use. They can be redipped, depending on their condition, every 2 or 3 yr. (He drew a diagram on the blackboard illustrating how rain comes into the pile at a certain point.) If the cover is extended 18 in. over the edge, the water will run off, eliminating danger of any blowing back into the stack. When the pile is taken down, the roof panels can be stored until the next season.

Mr. Grunwald: You might spray with chemical (borax). It stops growth of weeds on top of the stacks, and is a good investment. It does not burn anyone—the chemical is harmless; it will last you for a number of years; some stacks are 3 yr. old. Spray the two top layers. It takes 350 lb. for a whole rick—only the top tiers. A carload lasted close to 3 yr.

Mr. Adair: Did you actually use that straw in your mill?

Mr. Grunwald: Yes.

Mr. Adair: How much got away from you?

Mr. Grunwald: Some looked like a garden, but the borax-treated stacks did not show any growth. Whether top stacks were better I do not know.

Mr. Krancher: We had used borax 4 yr., but it was not effective in small amounts. It had stopped weed growth and was effective only for the first year; it did no good if carried over into the next year. I figured we saved 35 or 40 tons of straw that would otherwise be decayed.

E. M. Pyatt, Ball Brothers Co., Noblesville, Ind.: Four or five tiers should be treated, particularly if the straw is loosely piled. Dense bales and well-stacked bales are the answer to the straw deterioration problem.

Mr. Aronovsky: If you have wet straw in the middle of the pile, you cannot do much to prevent rotting. Do you borax people have anything to add? Are you treating any other fibrous materials?

Borax Co. Representative: Not much has been done in the last few years. We are treating bagasse in Puerto Rico.

Mr. Aronovsky: Does anybody use anything besides borax? (There was no response to this question.)

7. "What causes the loss of weight of baled field-dry wheat straw during a year's storage in a barn?"

Mr. Aronovsky: Does anybody have the answer to this question?

Mr. Adair: Air-dry straw lost about 10% in weight in 1-yr. storage in a barn. Basically, we have accepted a 10% moisture content. Is straw actually air-dry at 10% moisture, or should it be more? Are we right in assuming a moisture content of 10%, or should it be more?

Mr. Aronovsky: Was the moisture sampling sufficiently representative?

Mr. Adair: Ten tests on one bale.

Mr. Aronovsky: The moisture meter could be off, or the bales were not sufficiently dense. Compressing a 50-lb. bale to 70 lb. shows a higher moisture content with the meter. If the bale is not dense enough, the apparent moisture content will be low, as was shown several years ago at Alton.

Mr. Lathrop: The moisture content of straw will vary with atmospheric conditions, which depend upon the time of day. You might make a search of the literature to determine the relative humidity moisture curves. The moisture content of straw on the basis of air-dry straw would probably be between 10 and 12%.

Mr. Hosterman: I know of no work showing relation of humidity to moisture content. We have the same problem in grain. Some work was done by Fellows and Coleman on moisture in grain, and it is to be resurveyed.

Mr. Aronovsky: The moisture content of grain is 13 or 14% when harvested—straw contains about 2% more at the time.

8. "What is the optimum size of straw bale desired? What is the minimum density of bale required for stockpiling the straw in ricks?"

Mr. Aronovsky: At a joint meeting 4 yr. ago with farm equipment manufacturers, we arrived at a 16 by 18 by 42-in. bale with a minimum weight of 65 lb. air-dry (90% dry) straw. Are any changes desirable along those lines?

Mr. Bush: Farther back than that we desired a minimum of 70 lb. Last year we received some bales from Canada that weighed 110 lb. The heavier they are, the better we like them! We do not like them less than 75 to 80 lb.

Mr. Lyon: Ninety per cent of the suppliers will not make the larger size; 55 to 60 lb. is a very good average. We would like them much heavier.

Mr. Aronovsky: Do 55-lb. bales stand up as well?

Mr. Lyon: No.

Mr. Aronovsky: Do the suppliers get paid by the bale?

Mr. Lyon: We use the bale count to arrive at dockage when straw is wet.

Mr. Lathrop: Harold, aren't you inviting trouble in buying by bale rather than by weight?

Mr. Lyon: It is hard to get the farmer to make heavier bales.

Mr. Bush: We had one shipper who wanted to ship us 500 cars—we limited him to 100. He loaded the biggest cars and the heaviest bales we ever got. He wants to get all the straw out in 35 cars—doing a real job of baling.

Mr. Adair: It all reverts to education. Size is no factor. All the straw we need is in that bale. Sixty-five pounds is not too much out of line for good density, 9.5 lb. per cu. ft.

Mr. Hosterman: There was a hauling problem in California, where a great deal of hay is moved to the vicinity of Los Angeles. When windrow balers were first used, this hauling problem developed. Truckers refused to handle light bales, and they would not handle a man's hay if they could not load a certain tonnage. The farmers put their hay up in the type of bale the trucker would handle. Bale sizes are quite variable.

Mr. Adair: The bales are getting lighter right along. Truckers usually get more from the farmer for hauling lighter bales.

Mr. Aronovsky: Perhaps the desired size should be specified in the news sheets sent to your suppliers.

9. "Is it possible to bale chopped straw 3 to 6 in. long? Can a chopper be attached to the pickup baler so as to do the chopping and baling in one operation?"

Mr. Aronovsky: About 3 yr. ago we went out to a farm and tried to bale up chopped oat straw, 2 to 3 in. long, in a two-wire baler, and one third of the bales came out okay. The local baler said he could easily bale 3 to 6-in. straw with a two-wire pickup baler. One could thus mow and cut and bale in one operation.

Mr. Hosterman: For a good many years the hay trade talked about baling chopped hay. The problem of baling chopped material has been tried with hay and has not proved too satisfactory. In Nebraska a number of years ago, an attempt was made to bale chopped hay. Several carloads were shipped East—1000 lb. of loose material was found in the bottom of the car at Beltsville. On the other hand, and I do not understand how they are able to do it, I was told that it was common practice in Australia to chop wheat and oat straw and hay to $\frac{1}{2}$ in. It was then baled and put in packages to ship to Borneo for use by the British Army. I conferred with the Australian at the International Grassland Conference and he stated that they were still doing that. I believe that they are using five wires.

10. "The available galvanized wire is too hard. Can anything be done to develop a satisfactory rust or weather-resistant wire to replace black iron wire for baling wheat straw? Is lead-annealed or aluminum wire feasible?"

Mr. Adair: Galvanized wire is too hard, and will not stand up.

Mr. Krancher: You can obtain good wire from Kokomo.

G. A. Zinkil, Central Fibre Products, Quincy, Ill.: I talked to Victor Mueller, president of Laidlaw Wire Co., and his answer was that they could supply galvanized wire in any stiffness desired, provided they had 60 to 90 days' notice; any specification can be met—roll or bale type.

Mr. Lathrop: I think there are probably specifications for these types of wire. We found with heavy bales that the wire we had used had too low an elastic limit. The bales tended to expand after baling and broke the wire.

P. H. Harrer, Allis-Chalmers Manufacturing Co., LaPorte, Ind.: The FEI, ASAE had worked out wire specifications. I do not know whether the specifications have been released. Bob Jones, Chicago, secretary of FEI, could advise you on the standard specifications of baling wire. This is not galvanized wire, but black wire generally used for baling.

Mr. Adair: We standardized on galvanized. We are convinced that is the only thing to use until something better comes along.

Mr. Lathrop: I think the FEI specifications have been published just recently.

Mr. Krancher: They are effective October 1.

Mr. Hosterman: When the wire situation was critical several years ago, we found that aluminum wire was not satisfactory.

Mr. Bush: We use galvanized wire only. We get ours from Laidlaw, and have had no complaints.

Mr. Lyon: We have had trouble with galvanized wire on automatic balers—it is returned six to eight times before a batch is used up. Everybody complains on galvanized wire regardless of brand of baler.

Mr. Harrer: The galvanizing slips off when it goes through the twisting mechanism and interferes with the working of parts that twist wire. That is probably the trouble, rather than a characteristic of the wire itself.

11. "What is the optimum size of wire for use with automatic pickup balers?"

MR. HARRER: The answer is 14½ gage. There is another gage for old balers in the field.

12. "What is the dockage for string ties? Does anyone refuse string-tied bales?"

MR. BUSH: We have been accepting them, but we pay a dollar per ton less. We think we should pay even less.

J. A. PENNING, Alton Box Board Co., Alton, Ill.: We do not even accept the string-tied bales this year. We store most of our straw on farmers' fields. In our yard it is difficult to differentiate between the two.

MR. GRUNWALD: We limit string-tied bales in quantity. For daily use we do not care too much. If a fellow has a load, we tell him, "Well, bring it next Wednesday." We think that two loads a day do not make too much difference.

MR. LYON: We give $2.00 per ton less for string-tied bales. They do not weigh as much. We get about 7% string tied. We get more such bales at 30 lb., but it is possible to get 60 to 65-lb. string-tied bales.

MR. DUNLOP: Our company did not buy any string-tied bales for storage this year.

MR. ARONOVSKY: We have had that question up here for about 4 yr. Do you get less string-tied bales offered you now? Are you having any effect on the type of bales being brought into your mill? Does refusal or docking act as a deterrent?

MR. LYON: Yes, it does. Farmers buy very few string balers except where they put hay or straw up for themselves. String bales are losing out.

MR. HOSTERMAN: For hay, most of the farmers prefer string baled. It is the trend now, however, that new balers are coming out with wire tiers. Farmers prefer string especially for their own use. The hay dealers oppose it also, but they handle it because they still want to be in the hay business.

MR. ARONOVSKY: At our meeting several years ago, the complaint against wire-tied bales was loose wire baled in with the straw. With improvement in baling equipment and methods, has the amount of wire in straw been reduced?

MR. LYON: I do not think that ever was too much of a problem. I think that was propaganda.

MR. HOSTERMAN: I believe all the newer type balers have eliminated that short piece of wire. In feeding hay, the big problem is to eliminate the hardware.

MR. BUSH: We do not have the trouble with the disk refiner but we do find a lot in the jordan. There is a terrific amount of pieces of wire in it when we clean it out.

MR. GRUNWALD: We have had the same experience. There are no big pieces but the fellows do not always pull them all out.

S. G. BRACEWELL, International Harvester Co., Chicago, Ill.: We clip the two pieces of wire and it is tied in a twist. No loose pieces to contend with.

MR. ARONOVSKY: Mr. Bush, are you accepting round bales, or refusing them?

MR. BUSH: We refuse to accept them.

MR. GRUNWALD: We do, too.

MR. LYON: Would not take them as a gift.

MR. BUSH: Our problem is getting a uniform cooking of the straw because the round bales will not disintegrate in the rotaries.

MR. KRANCHER: We found we could not cook them in the round form. We built a 30-in. saw mounted in a galvanized iron trough and driven by a 15-hp. motor. The straw becomes a loose mass when slit in two by the saw.

13. "Is anyone actually specifying bale dimension and weight in buying straw for paper purposes?"

MR. LYON: We take what comes. Try to keep impressing on them to make heavier bales.

MR. ARONOVSKY: Does anybody specify bale dimensions?

MR. ADAIR: I think we are getting longer bales, 40 and 48 in.; it would be better if we could have one specific weight.

MR. ARONOVSKY: Is there a definite bale size for hay, Mr. Hosterman?

MR. HOSTERMAN: No. On the Pacific Coast you encounter five-wire bales weighing 175 to 300 lb. In Canada and the northeast, there is a three-wire 17 by 22-in. bale. Canadian hay is still largely 17 by 22 in. weighing 110 to 175 lb. There are several smaller types, 18 by 18-in., 16 by 18-in., and for awhile there was a 16 by 16-in. size bale. They were whatever size the manufacturers decided the bale chamber would be. They are more or less standardized on 16 by 18 in. now, but there is still considerable variation. The length can be adjusted on balers pretty well by the operator.

MR. ARONOVSKY: It seems that if you were baling 16 by 18 in. and 18 by 18 in., you would have to be very careful the way you stacked them. The ricks I have seen seemed perfectly level across. Bale sizes must be fairly uniform throughout the straw-baling area.

MR. LYON: The majority are 16 by 18 in. or 14 by 18 in. now. International = 14 by 18 in., the rest of them 16 by 18 in.

MR. ARONOVSKY: Would this group express a preference?

MR. LYON: I would say 16 by 18 in. because you get more weight in them. The length does not matter so much.

14. "In general what moisture indicating instrument has gained acceptance by straw shippers?"

MR. ADAIR: The fact is they do not like it.

MR. ARONOVSKY: Do your shippers accept readings shown by your moisture meter?

MR. ADAIR: We have two inspectors on the job, and they inspect straw from 7 a.m. to 11 p.m. The inspector checks the load of straw with a Delmhorst and makes 20 sample tests on a load. He has a little pad, and has to put down what he finds; the shipper generally follows him around. He runs the total and gets an average. A 10% allowance is given. We have not had any trouble at all in the last 2 yr. Everybody has accepted our tests.

MR. ARONOVSKY: Is there a possibility of getting uniform purchasing in the industry by specifying straw to have either 10 or 12% indicated moisture and pay a premium or dock on what they deliver?

MR. LYON: We follow this same procedure and use 12%, but do not give any premiums. We take about 20 tests. We dock them for over 12% average moisture. Half test 14, half 10, it comes out even.

MR. KRANCHER: We use about the same methods as these two gentlemen, except we use rule of reason too. We use 10% moisture as our base. However, if the shipper brings in a load 11 or 12%, we do not dock for that. We feel the method of testing has that degree of error in it. If moisture is 4 or 5%, we do not pay any premium. If it runs up 15 to 20%, we start docking for moisture. Our man takes 10 to 15 readings and averages them in his mind. Some men take it for granted and some follow him around. We start docking from about 13% on up. Since we do not give a premium for exceptionally dry straw, we feel we should give a little variance off our base.

MR. ARONOVSKY: In the range up to 15% moisture, the conductometric tester was quite accurate. From 15 to 23%, it was fairly accurate. Beyond the fiber saturation point, it was just testing water. The biggest variable was the bale itself, with wet and dry spots. An important variable is density of the bale. Are farmers beginning to trust the instruments more?

MR. ADAIR: Farmers accept it generally, but you will always have arguments.

MR. LANDWEER: In my country the Delmhorst moisture tester is used. We count bales and when the average for a bale is too high, we cut down the price. We dock on the whole carload.

MR. HOSTERMAN: One of our problems is the question of moisture in hay. In our standards we set a maximum limit of moisture for hay to be classified as hay. We use a rule-of-thumb method to determine whether hay is cured or undercured. Inspectors acquire the ability to tell by the feel of

hay whether it is cured properly. A considerable quantity of newly harvested hay is received at a number of the markets, especially Kansas City, and the inspector has to decide whether it is cured or undercured without the assistance of any method for determining moisture. We have not found a satisfactory moisture tester for hay. Our agency is starting a research project to investigate various types of moisture meters, reviewing work on grain, and possibly finding something to use on hay. Results are "very much in the future." A probe of some kind is the practical instrument. We have had a Delmhorst machine in the laboratory, but have not used it to a sufficient extent to express an opinion. We want a piece of equipment the inspector can use; we have no idea as to what type of instrument it will be, but hope it will be a probe type. In grain inspection work they can use the other types. "Tag" machines are used in our field offices for determining moisture in grain. The moisture problem is perennial. There is a need to know more about moisture and its relation to agricultural products.

MR. ARONOVSKY: What is the moisture range of cured hay?

MR. HOSTERMAN: If cured to 20–22% moisture, it will stand storage. Much over 25–28, you will have some heating in the bale. The agricultural colleges had done some work along these lines.

MR. ARONOVSKY: I suggested to Delmhorst that he contact experiment stations and finance a small research project to correlate moisture readings.

MR. HOSTERMAN: He is doing that with the New Jersey Agricultural Experiment Station now. That point where these electric instruments are not accurate is somewhere between 20 to 23%.

15. "What are the approved methods of checking the moisture content of straw as received?"

MR. ARONOVSKY: What do you do as a final check?

MR. KRANCHER: At 40% moisture and above, the Delmhorst instrument does not measure moisture accurately. We often had trucks covered with ice and snow. Then we took samples from whole bales, dried and weighed them and found 40% or more moisture in them. The shippers were satisfied with such tests.

MR. HOSTERMAN: Have you used cores as a method of determining moisture? We have been using the hop sampler for hay. It is a short tube around 12 to 14 in. long with a plunger. The Bureau of Dairy Industry, U.S.D.A., samples bales of hay by using a core cutter on an electric motor, a long tube with a serrated cutter knife. They cut halfway through a bale of hay that way.

W. M. SCOTT, Bureau of Agricultural and Industrial Chemistry, U. S. Department of Agriculture, Washington, D. C.: The wool people have a means for sampling wool, but no instrument is used in sampling cotton.

H. M. SUTCLIFFE, The Celotex Corp., Marrero, La.: Bagasse having 50% moisture is stacked with foot-wide vent ducts running crosswise and lengthwise at 6 and 12-ft. intervals. It is heated enough by natural fermentation to dry the bales to 13 to 15% moisture, pasteurizing the bales at the same time and giving a mild cook. We do not worry too much about preservation. In the past, boric acid has been used, but the practice is being curtailed. Covered stacks having proper ventilation appear to be of prime importance.

MR. ARONOVSKY: Do you check moisture on bales as they go into the mill?

MR. SUTCLIFFE: There is no testing there at all.

16. "How can one readily determine the amount of chaff and other fine materials in the baled straw? How can the amount of dirt and material other than cellulosic be determined readily? What is the maximum allowable chaff content of baled straw and how is dockage for chaff determined?"

MR. LYON: I do not think anyone deducts for chaff any more. I do not think chaff is any problem at all, any more. Dirt probably would be, but we do not pay any attention to it.

17. "Can anyone suggest a method of determining the weed content of baled wheat straw? What is the maximum allowable weed content of straw for papermaking? What is equitable dockage for weeds and how is it arrived at?"

MR. LYON: We estimate weed content just by looking at the straw. If it shows over 5% weeds we cannot use it at all. our graders just look at it. They usually break open a bale. Weeds are generally tender and green.

MR. ADAIR: I do not think anyone has been confronted with this problem too much, but there should be some setup to count or weigh weeds. We have not been faced with the situation. The last 2 or 3 yr., we have had pretty good straw. Clover is a foreign material and it should be counted as a weed.

H. D. HENLEY, Container Corp. of America, Carthage, Ind.: We dock for weeds and clover as much as the traffic will stand.

MR. LANDWEER: We have a little trouble, but not so much as this country. We just pay 5% less price on weight. You can see from the outside of the bale if there is a lot of weed—it is called unacceptable then.

MR. SACKETT: Don't you get weeds over there?

F. M. MULLER, Netherlands Experiment Station for the Utilization of Straw, Groningen, Netherlands: We grow grain in a different way in Holland. We use a lot of fertilizer. Weeds do not get a chance; one stem is next to the other, so that hardly any weeds can develop.

MR. ARONOVSKY: You use a combine?

MR. MULLER: Between 10 and 20% is harvested with combine.

MR. ARONOVSKY: Do you just take the grain with the combine, or mow low enough to get all the straw you use?

MR. MULLER: That depends on the type of combine. Some leave a stubble of 4 in.; others may leave a longer stubble.

MR. LYON: If it has much over 5% weeds, we send it home. Our 15 graders use their own judgment; they do not generally dock for 2 or 3% weeds.

18. "Can weeds be eliminated from straw after a wet growing season?"

MR. LYON: I do not see how that could be.

MR. ARONOVSKY: You cannot harvest wheat when too wet. Mr. Lyon, do your suppliers use 2,4-D?

MR. LYON: I do not know.

T. R. NAFFZIGER, Northern Regional Research Laboratory, Peoria, Ill.: One can windrow and then pick up with a combine—the weeds will be dry; one might not combine for 2 or 3 weeks.

MR. SUTCLIFFE: 2,4-D is not used unless weeds are a problem. It is rather expensive; people usually hope that weeds will not give them any trouble.

MR. HOSTERMAN: In our methods of determining mixtures in hay and straw, we take samples from the hay and straw and separate the types of grasses, legumes, and foreign material. My observations indicate that ordinarily 5% of weeds or mixture will not be seen in the bale. I wonder whether this 5% that you talk about isn't nearer 15 than 5%. It is rather interesting to note that you can develop the ability to estimate the percentage of mixtures and foreign material if you have some basis on which to make an estimate. You can train inspectors to see percentages in the neighborhood of 5% steps. I believe that, with basic information, the inspectors can develop a pretty good idea of percentages. In the hay standards which were established by the National Hay Association many years ago, mixtures were expressed in 1 and 2% steps. It was found that their idea of 1% might be as much as 10% when the mixtures were separated and the actual percentages determined. By taking samples from a bale and separating them and then using the remainder of the bale for training, we can develop the ability to estimate various percentages fairly accurately.

F. LOWE, Weston Paper & Manufacturing Co., Terre Haute,

Ind.: There is nothing we can do about it so far . . . I imagine that with 5%, we are not docking enough.

MR. SACKETT: There is more fiber in the weed than in the crop.

MR. ARONOVSKY: Some of those weeds are actually hardwood in chemical composition and in amount of hemicellulose and lignin, but they have very short fibers.

MR. MULLER: For fine pulps the weeds do not cook up so we throw them out. In corrugating, the weeds show up in the pulp. There might be a possibility of screening them out.

19. "Is the suitability of straw for papermaking affected by the color, i.e., bright yellow versus gray? Does straw which has suffered some weathering affect the quality of the resulting pulp if the straw does not appear to have been attacked by microorganisms?"

MR. ARONOVSKY: Has anyone here determined whether weathered straw would affect pulp for paper?

MR. GRUNWALD: Some stored straw changes color. We have not found too much difference. For corrugating I do not think it makes a bit of difference.

MR. KRANCHER: We think weathered straw does not give quite as good a pulp. I think if it could be segregated, you could get equal papermaking properties, but we do not have any way of segregating it. I think we do suffer some loss in yield. Decayed straw causes the most trouble.

MR. ZINKIL: We do not make any particular point of separation.

20. "Does anyone use oat, barley, or rice straw for corrugating pulp? What are the effects of rice, oat, and barley straw on the properties of the corrugating paper produced from these straws? How do these straws stand up in stacking and storage?"

MR. GRUNWALD: Some farmers will not sell wheat straw unless some oat straw is also accepted. At given times our company will take it, never over 10 to 12% of daily consumption. We never used barley or rice straw.

MR. ARONOVSKY: What types of oat straw?

MR. GRUNWALD: Just oats. I would not know.

MR. LYON: The way our plant feels now, if there is any wheat straw available in the United States, we will buy it before buying other straw. It is worth twice as much as oat or other straws. We see no advantage of Clinton over other oats.

MR. SACKETT: We have given up the idea of trying to use oats, and we get hardly any barley.

MR. KRANCHER: You did not mention rye straw.

MR. MULLER: As a matter of fact, rye is our most important grain crop. In 1949 there was 42% rye and 25% wheat and oats, and 8% of barley. We did find that rye was by far the best straw for the manufacture of paperboard because of high percentage of fibers; winter wheat was second, and summer wheat and oats below, and barley lowest of all. You will find, for instance, that one of our straw paper mills tries to get hold of as much rye as possible. That is the general experience in Holland. Rye straw has the advantage of a lower solubles content, about 8%; oats, on the other side of the scale, may be as high as 15% in water solubles.

A. EXTROM, Alton Box Board Co., Alton, Ill.: What is the B.t.u. content of waste liquors?

MR. MULLER: I would not know. Only one mill has that system, and I do not know.

MR. LYON: What is the yield of wheat grain?

MR. MULLER: The average yield is about 1.2 metric tons per acre. It may run up as high as nearly 2 tons per acre.

MR. ARONOVSKY: We have covered all of the questions that were sent in for this round-table discussion. Now, I should like to get an expression from this group as to the goal you want to set for optimum standards of baled straw. In April, 1946, we set up 16 by 18 by 42 and weight 70 lb., which is 10 lb. per cu. ft.; chaff, under 5%; height of stubble, 3 in.; moisture, same as at harvest time. It must be practical as well as optimum.

MR. PENNING: We would like to standardize to a length of 48 in. before emerging from baler. More bale weight that way.

MR. LYON: That 48-in. bale would be fine except it tears up our tracks, and they have to be repaired very often.

MR. PENNING: You have to set up a standard.

MR. LYON: That would be the ideal bale.

MR. ARONOVSKY: Would a 48-in. bale requirement be too difficult to attain?

MR. BUSH: If it isn't baled tight, it would collapse before getting into the stack. I would rather have 42 in. than 48—that is more stable.

MR. GRUNWALD: I would not want any 48-in. bales. They would buckle.

MR. PENNING: The cost enters into it. We are interested in getting the least number of bales out of the straw. We do not have the methods of weighing in the field. Most of our men buy by the bale.

MR. LYON: We recommend the balerman pay the farmer on our weights, on mill weights. Straw should be baled on the basis of weight.

MR. ARONOVSKY: What would happen if you refused to take loose bales?

MR. BUSH: We probably would have to shut down the mills because of lack of straw!

Annual Dinner

At the annual dinner on Monday evening, October 27, the chairman invited several of the guests to say a few words. J. Koski, project manager, Productivity and Technical Assistance Div., Mutual Security Agency, Washington, D. C., described the tour of the Netherlands delegation thus far, and remarked that they had been received very cordially by everyone. D. G. Landweer, owner-managing director, Scholtens Board and Paper Mills, Groningen, Netherlands, spoke briefly on the strawboard and straw-paper industries in the Netherlands and pointed out that straw is their main indigent raw material for pulp and paper production. F. M. Muller, director, Netherlands Experiment Station for the Utilization of Straw, Groningen, described the research work of his station, particularly on the utilization of straw for pulp and paper.

The speaker of the evening was C. O. Smith, industrial engineer, Hiram Walker and Sons, Inc., Peoria, Ill., whose address follows.

What We Expect of a Corrugated Shipping Case

C. O. Smith

BEING the only user speaking to a group of paper and corrugated board manufacturers, I am really laying myself wide open in the comments which I am going to make. Because of the fact that I am not familiar with the technical terminology which you gentlemen use, I shall attempt to stay away from the use of such terminology insofar as it is possible. I believe that by doing this we will both better understand the point which I am trying to make.

When your chairman asked me to speak at this meeting, I should have told him that I would discuss "What we want in a corrugated shipping case." By so doing I could have made my speech very very brief. We are looking for a corrugated shipping case that can be stacked 20 high, will never lose its shape, and which will reduce our shipping claims for broken glass to an irreducible zero. Furthermore, we want this case to do these things regardless of climatic conditions, and of course we want it at the same price that we are now paying.

Don't worry, gentlemen, we don't expect to find it today.

Seriously though, I should like to discuss with you what we,

C. O. SMITH, Hiram Walker and Sons, Inc., Peoria, Illinois.

as members of the distilling industry, expect of a corrugated shipping case. This, of course, will give you only a picture of one industry and another industry might not expect the same thing from a shipping case that we do.

Let us go back and take a look at the development of the shipping case. Originally the corrugated shipping case was in our industry a substitute for a wooden case in which the bottles were protected by straw hoods. In its original design, the only purpose of this shipping case was to protect its contents. However, today with modern methods of operation, mechanical handling, and with modern advertising methods, this same corrugated shipping case serves many additional purposes. I say additional because its basic purpose is still to protect its contents.

Now, let us take a look at the work these cases are expected to do. We use what is known in our industry as reshippers. That is, the case is made up and packed at the glass factory. The glass is packed necks down and the bottom of the cases are sealed. We use a tremendous amount of glass, and to give you some idea of the quantity which we do use, our consumption at the present time is in the neighborhood of 600,000 bottles per day. We keep very little of this ware at our plant, and it is not unusual to find that the glassware is packed and stored at the glass factory for as much as 60 days. In an isolated instance it may exceed 60 days. From the glass factory this ware is shipped by car or truck to our plant. Upon receipt at our plant, it is handled mechanically by hoist and conveyor, or pallet fork truck and conveyor from the truck to the bottling line where it will be used. We operate on a very tight unloading schedule, having the trucks arrive every 2 hr., and it is not unusual to have the first of the ware filled and ready for shipment before the last of the incoming ware has been removed from its truck.

As mentioned previously, the incoming glass is handled by conveyor to the particular bottling line on which it will be used. In its travel on this conveyor the case will be upside down, with the sealed bottom of the case up. From these conveyors it is fed mechanically into mechanical unloaders where the lower flaps are open and the bottles drop out onto an unscrambling unit for feeding on the bottling line. After being unloaded the case travels by conveyor through the stenciling department where necessary information is stenciled upon it and then sent to the packing station where the filled bottles are packed in the case. The case is then sent through the case sealing unit and carried by conveyor to the shipping department for loading in either railroad car or truck for shipment to one of our distributors.

I think you can readily see that in order for a case to withstand all of this handling it must have a lot of structural strength. It must have structural strength sufficient to stand not only this handling which will amount to not less than 12 times on each case, but it must have sufficient structural strength also to withstand stacking under conditions which are not always ideal. The structural strength of the case must be such that under this handling and stacking it will retain its shape, as in our many operations, shape is a very important factor. The case must also protect its contents against breakage. The corrugated board from which it is constructed must be able to take adhesive in order to give a proper seal. The inner surfaces of the partitions and the inside of the case which comes in contact with the bottles must have smooth enough surfaces so that they do not scuff the labels. The board used on the inside of the case must be such that it is free from lint. These last two points are very important to us as appearance means a great deal with a whisky or gin bottle. The outer surfaces of the case must take printing, both advertising copy and that printing which is required by the government. Last but not least, these shipping cases must comply with Rule 41 of the Consolidated Freight Classification.

In order to accomplish these things, what do we specify for our cases? We use two different specifications for shipping cases: One, a specification covering quarts and fifths and the other covering pints and half pints. The shipping case for quarts and fifths is a 200-lb. test CSSC style shipping case. It has a single wall outer constructed of 42-lb. kraft facings and a 0.009-in. Chemfibre corrugating medium, using C flute corrugations. For this case we use double wall B and C flute partitions having a 33-lb. kraft outer and center facings and a 0.009-in. Chemfibre corrugating medium. The shipping case for pints and half pints is a 200-lb. test RSC style case, having a single wall outer with 42-lb. kraft facings and a C flute 0.009-in. Chemfibre corrugating medium. The case has a nontest liner of single wall corrugated, using a 0.009-in. Chemfibre facing and a corrugating medium. Its partitions are of a single wall corrugated, having 42-lb. facings and C flute 0.009-in. Chemfibre corrugating medium. Top and bottom nontest pads, of the same materials as the nontest liners, are used in this case. All corrugating medium used in this case is C flute.

We do not believe that these specifications give us the best possible shipping case, in fact, at the present moment we have a case which has been produced under another specification, which is under test. It is expected that this case which is being tested will be a better case than the case which we are specifying today. We are continually investigating new shipping case designs and testing new materials, in an attempt to obtain a shipping case which is superior to the ones we are presently using.

Some of the difficulties which we are presently experiencing are: (1) insufficient structural strength for stacking, and storage in humid conditions; (2) inability of the case to retain its shape when handled under humid conditions; and (3) warped partitions. Failure resulting from one of these three items gives us trouble in the mechanical handling and unloading of these cases.

At this point I should like to call attention to one of the weak points in the evaluating of a corrugated shipping case. There are no adequate testing and rating methods available for this purpose. You give me bursting strength, puncture, flat crush, compression, ring, impact, drop, and drum ratings for your particular case or corrugated board, but all of these ratings will have been made under controlled climatic conditions, which have been artificially produced. They tell us nothing of how the board or case will act under climatic conditions which will be actually encountered in the use of any particular shipping case.

You men of the paper industry have done much to improve the quality of the corrugated shipping case of today. You know that it is possible, using different type sheets, to produce two kinds of corrugated board which will give comparable ratings under present testing methods. However, you also know that when these two boards are exposed to humid conditions one may be far superior to the other. We must use these shipping cases on a hot rainy August day as well as on a cool dry Fall day, and the ratings given under present test conditions do not tell us which type of corrugated is the better to use. We want actual performance ratings, values that will tell us these differences, not just theoretical values. As an engineer I am confident that one of these days some one will give us this practical performance rating method that we are looking for, and when this has been achieved it will be another step forward in the development of the corrugated shipping case.

Tuesday, October 28

Mr. Aronovsky placed the following items on the blackboard, for consideration: moisture, chaff, weeds, dirt, weight, size, density, ties, and color.

Mr. Aronovsky (after summarizing briefly the previous day's discussion): I wish to find out what the group desires in straw for pulping, what should be used as a standard moisture content in purchasing straw. I think 12% would be

more realistic for the moisture content of straw as it comes from balers.

MR. GRUNWALD: I think there is not too much difference between 10 and 12. Ten per cent is easier to figure than 12.

MR. BUSH: When it is air-dry, we consider it dry straw, assuming there is not excessive chaff or weeds. We do not use a moisture tester. I do not know of any accurate way to tell what the moisture content is, besides oven drying, of course.

MR. LATHROP: I have a suggestion to make. Put down "moisture air-dry, not to exceed 12%." That moisture content is pretty close to air-dry. As Fritz says, the difference between 10 and 12 is very small. You want to buy air-dry straw—that is what you want. If you have a "not to exceed" figure, you are all right. I do not think you need a lower limit. The four items in the first column on the blackboard could all be on the basis "not to exceed." For moisture, you might put, for a qualification, air-dry, perhaps. (There was general agreement to this.)

MR. ARONOVSKY (after reviewing the decision that chaff and weeds had to be under 5%): Who is going to determine what is 5%?

MR. BUSH: There is also a difference in weeds. We estimate 10% weeds. We get half of the fiber out of the weeds. We make a deduction of only 5% if we estimate 10% for weeds.

MR. ARONOVSKY: Do you want to put in a factor for dirt, a numerical value? Soil, rocks, and things of that sort?

MR. GRUNWALD: I do not think dirt is a big item. If we start to talk about dirt, the farmers are going to think we all went "nuts" overnight.

R. A. SPRINGER, Diamond Alkali Co., Painesville, Ohio: Chaff and dirt could all go together. . . . You should have a certain amount of fiber that can be utilized in the mill.

MR. ARONOVSKY: You are saying "not under 90% fiber?"

MR. SPRINGER: That is right.

MR. LATHROP: It should be understandable to the farmer. Put your finger on the objectionable material. "Here is the chaff," or "here are the weeds; that is what we object to."

MR. ARONOVSKY: What about weight?

MR. GRUNWALD: Seventy pounds.

MR. ARONOVSKY: And size—16 by 18 by 42? or 38? or 48? I do not think size means very much, actually. Weight and density are what really count. Density should be 10 lb. per cu. ft. Any comments on color of straw?

W. D. LEWIS, Muskingum Fiber Products Co., Coshocton, Ohio: Yellow straw is hard when not dead ripe. Gray straw is dead ripe that has probably laid out in the wet and bleached out; it does have an effect on the fiber. It makes the fiber brittle. The amount of chemical would be reduced if one used bleached straw totally. If one takes that straw itself and puts it in a digester, a lot of difference would be seen. Bleached straw hydrates much easier.

MR. ARONOVSKY: No other comments? Should we put that in as one of our specifications?

MR. LEWIS: It could be put in, but I do not think it would do any good.

MR. HOSTERMAN: In order to find out what type of material you are working with, it is pretty important to get samples of the material and have some analyses made to find out where you stand. There has been a lot of talk about chaff and weeds, but I would assume that those estimates are more or less curbstone opinions. You should actually have an analysis of the types of straw you are using that are satisfactory, and find out specifically how much of these various materials are in them. We have done a great deal of that. We know when we take a sample, have a group estimate what is in it, and then separate it, the estimate does not always agree with what we find. We could train people to apply those factors reasonably accurately. You folks should be particularly interested in having work done on types of satisfactory straw to find out what the percentages of various fractions should be. I am not in a position to say what the department, that is, our branch, could do if you wished us to give you some assistance. If you are interested, a letter to the director of our branch asking for such assistance will be given consideration, and if they feel that they can do the job with available funds, they will be glad to give you some assistance. With reference to the inspection service which we maintain, I probably did not make it clear yesterday that that service is entirely permissible. If we can be of service by giving you an inspection service, we will be glad to do it but the request must come from the industry. The main point here is to try to find out by actual separation what kind of straw is satisfactory. I stated yesterday that I thought 5% estimates were low because of our experience in separating samples and then re-examining them.

MR. ARONOVSKY: The inspection service, then, is just a referee service?

MR. HOSTERMAN: That is exactly it.

MR. ARONOVSKY: We will have to leave this subject. I suggest all of you think about this, and at our next annual meeting we will devote a couple of hours to try to bring the specifications to a head and agree on them, and then see if we can get the strawboard mills to work together and buy on these specifications.

Fall Meeting Plans

MR. ARONOVSKY: There will be no subcommittee reports at this time because the chairmen are not present. We want to make plans for the February and Fall meetings in 1953. There is not enough time to set up a technical session for the February meeting. It is difficult for many of you to attend the Annual Meeting in New York, so we are planning to have just a small business session of the committee for as many of you as come to the Annual Meeting. I should like to see our Fall meeting next year at a mill site. There are three possibilities: Quincy, Ill.; Sandusky, Ohio; or Trenton, Ont. We will try to contact representatives of these mills. We have to have hotel capacity and meeting room accommodations for 60 to 80. A number of mills would like to sponsor our meetings, but they do not have sufficient hotel accommodations.

MR. LEWIS: The Coshocton Hotel is not yet completed; there is a hotel 40 miles away.

MR. GRUNWALD: Monroe does not have facilities, either. Detroit is too far. Toledo is 20 miles.

MR. ARONOVSKY: What main subject should we take up at the Fall meeting?

MR. GRUNWALD: I suggest that crush resistance and strength properties of corrugated paper be considered.

MR. ARONOVSKY: That is a good subject and I think it should be set up as a round-table discussion.

MR. BUSH: Crush resistance is very important. The wood people are making improved board, and we will have to improve our strawboard to keep our business. I have always contended there should not be a ton of paper made out of wood that could be made out of straw, but I do not believe there has been a new straw mill built in the last 25 yr. There are fewer now than there have been in the last 30 yr.

MR. ARONOVSKY: There has been no concerted research to any large extent done on improving strawboard except for mechanical operations and machines. We need it badly.

MR. LEWIS: We are thinking of converting to wood. We are doing some research on that now, for the simple reason that Mr. Bush just stated. I definitely know that if we would put the money into the straw mill that we would have to put into the wood change-over, we could make more tonnage and at least as good a sheet of paper. I think we have to have a complete rejuvenating of our plant.

MR. JOHNSON: I am in agreement with all that has been said here. We should improve the crushing strength of straw and go at it fast. I would like to add one more thing. We say crush tests; don't you think it would be well if we could tie that into stacking? I mean crush strength of the corrugating medium is usually an indication of how well the

finished box would stack and stand up. In our study, couldn't we tie that in a little? How high does crush strength have to go in order to do a job? Does it have to be 400 lb. on 10 sq. in.? If crush strength of 300 lb. would allow you to stack boxes up 16 to 18 ft. high, isn't that the solution to our problem? Maybe 250 is the answer.

MR. LATHROP: Are you familiar with the work being done at the Forest Products Laboratory with the Quartermaster Corps? They have been working with the Quartermaster Corps in an endeavor to get at this problem of resistance to compression of cases during storage. They have developed a formula, using component parts of the box, such as liner, and corrugating material by which compressive strength at various humidities may be calculated. They showed me a slide rule they developed based on some of these formulas, so that, given a certain amount of test information, they can tell you, with some accuracy, the effect of storing these cases 15 or 20 ft. high for a certain length of time under different humidity conditions. The Northern Laboratory and the Forest Products Laboratory have carried on considerable cooperative work. The strawboard manufacturers might be able to interest the Forest Products Laboratory to undertake similar work for them. The work could be reported in trade journals and would be an effective way of advising of the improvement made in strawboard manufacture. Forest Products is set up to take money grants from industries to do these things. They are interested in the wide viewpoint, of having some way to predict box properties; furthermore, they are in very close contact with military people who use an enormous amount of material.

MR. JOHNSON: If we could make a medium with high crush strength, that will hold up at high humidity, that would be very fine.

MR. ARONOVSKY: Crush resistance alone, taken by itself, will not tell the story. It has to be correlated with the end use of that particular material.

S. D. WELLS, Institute of Paper Chemistry, Appleton, Wis.: In the '20's, at Forest Products Laboratory, we found that pulped with neutral sulphite, new box fillers did not have an odor. We found we could double the crush strength of corrugated board. It cost 50 cents more for fillers to be placed in cases for 30 dozen eggs. The manufacturers were not going to pay for it, and did not have to. Quincy mills' straw kraft was used. One could count on almost double crush strength; however, it cost more money. One could sell all the lime-cooked straw he wanted to when selling was tough; when some mills were down, they took the excess and some had all their machines covered. One could not charge any less at that time, but there was no objection or penalty to putting more money into one's cooking process and getting added benefits. In that way, they were able to put two idle machines to work. The correlation between those tests and actual performance is what we need. Old straw mills have to be modernized.

MR. ARONOVSKY: Is everyone agreed on "Crush Resistance and Other Strength Properties of Strawboard" as the subject of a round- table discussion at our 1953 Fall meeting? (All agreed.)

The chairman then brought up the subject of a TAPPI-sponsored project, and pointed out that the project submitted by this committee in 1952 was turned down, mainly because it was too general and indefinite in scope. After some discussion, it was decided that this subject would be taken up at the committee meeting during the Annual Meeting of TAPPI in New York in February, 1953.

MR. ARONOVSKY: I want to thank all of the committee members and guests present for your wholehearted cooperation and participation in this round-table discussion. I also want to think Mr. Milner and members of the Northern Laboratory staff, and particularly Miss Betty Wilson who was kept busy taking down the discussions, for their cooperation in making this meeting so pleasant and successful.

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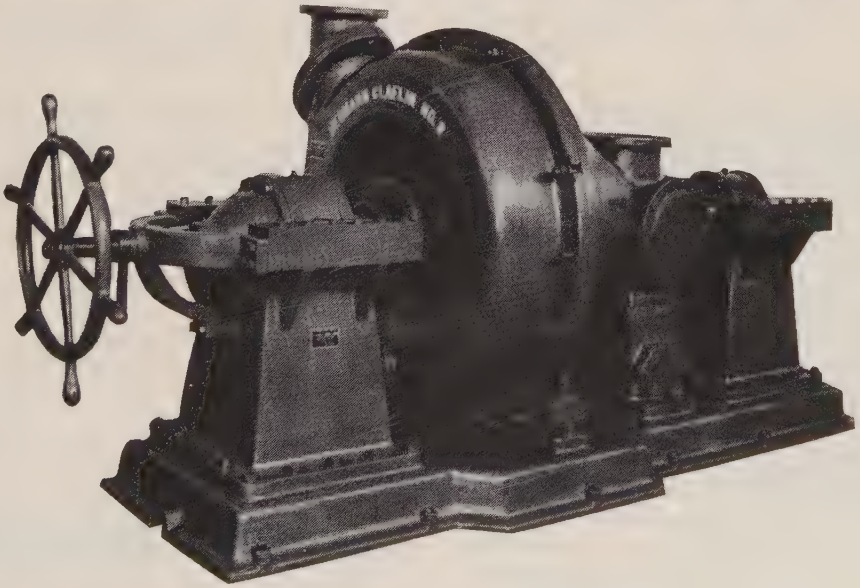

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Standard Terms Used in the Sulphate Pulping Process

Proposed Revision of TAPPI Official Standard O 400 p-44

(THIS STANDARD IS UNDER THE JURISDICTION OF THE ALKALINE PULPING COMMITTEE)

1. TOTAL CHEMICAL: All sodium salts, expressed as Na_2O.

Note: Total Chemical is limited herein to salts of sodium (including potassium and other alkali metals, if present), expressed as Na_2O. Sulphur and calcium are recognized as important process chemicals, but are not included in this standard because procedures for their analysis and/or material accounting have not been as well established.

2. TOTAL ALKALI: $NaOH + Na_2S + Na_2CO_3 + {}^1/_2Na_2SO_3$, all expressed as Na_2O.
3. ACTIVE ALKALI: $NaOH + Na_2S$, expressed as Na_2O.
4. EFFECTIVE ALKALI: $NaOH + {}^1/_2Na_2S$, expressed as Na_2O.
5. ACTIVITY: The percentage ratio of active alkali to total alkali.
6. CAUSTICIZING EFFICIENCY: In white liquor, the percentage ratio of NaOH to $NaOH + Na_2CO_3$, both items being expressed as Na_2O, and being corrected for NaOH content of the original green liquor in order to represent only the NaOH produced in the actual causticizing reaction.
7. CAUSTICITY: The percentage ratio of NaOH, expressed as Na_2O, to active alkali.
8. SULPHIDITY: The percentage ratio of Na_2S, expressed as Na_2O, to active alkali.
9. REDUCTION: In green liquor, the percentage ratio of Na_2S to $Na_2SO_4 + Na_2S$ + any other soda sulphur compounds, all expressed as Na_2O.
10. UNREDUCED SALT CAKE: Na_2SO_4 in the green liquor, expressed as Na_2SO_4.
11. MAKE-UP CHEMICAL CONSUMPTION: The pounds of Na_2SO_4, or other sodium compounds expressed as Na_2SO_4, added as new chemical per ton of air-dry pulp produced.
12. CHEMICAL RECOVERY: The percentage ratio of total chemical to the digesters, less the total chemical in new chemical, to the total chemical to the digesters (after correcting for any change in the liquor inventory).
13. CHEMICAL LOSS:

    (a) *Total:* The percentage ratio of total chemical in new chemical to total chemical to the digesters.

    (b) *Loss in cooking and pulp washing:* The percentage ratio of total chemical to the digesters, less the total chemical to the evaporators, to the total chemical to the digesters.

    (c) *Loss in evaporators and furnaces:* The percentage ratio of total chemical to the evaporators, plus total chemical in new chemical, minus total chemical in the green liquor, to the total chemical to the digesters.

    (d) *Loss in recausticizing and mud washing:* The percentage ratio of total chemical in the green liquor, minus the total chemical in the white liquor, to the total chemical to the digesters.

Note: All above items should be corrected for any change in liquor inventory.

14. GREEN LIQUOR: The name applied to liquor made by dissolving the recovered chemicals in water and weak liquor preparatory to causticizing.
15. WHITE LIQUOR: The name applied to liquors made by causticizing green liquors. White liquors are ready for use in the digester.
16. BLACK LIQUOR: The name applied to liquors recovered from the digesters, up to the point of their incineration in the recovery plant.

Notes: (1) In reporting laboratory data the Na_2O is to be expressed as grams, while in reporting mill operations the Na_2O is best expressed as pounds. When expressing concentration, grams per liter is preferred for laboratory work, while pounds per cubic foot is the recommended basis of mill reports. In any case, all articles written for publication should clearly state which basis is used in order that the reader may be able to calculate to any comparison preferred.

(2) In the calculations based upon green liquor, the analysis should be corrected for the content of the weak liquor usually used in dissolving the smelt.

(3) For rapid mill control purposes, Total Alkali may be used instead of Total Chemical in Items 12 and 13, provided Na_2SO_4 is included with Total Alkali in Item 13 (c).

Paper and Packaging Specifications

FEDERAL STANDARDS

The following information on Federal Standards of recent issue comes from Robert B. Hobbs, Chief, Paper Section, National Bureau of Standards.

A new series of publications known as Federal Standards, intended to achieve the highest degree of uniformity and standardization for the Federal Supply System, has been initiated by the General Services Administration. Each standard covers

items of a particular commodity conforming to a Federal specification, and requires that purchases under the applicable Federal specification shall be limited to items conforming to those listed in the Standard. New Federal Standards for paper and paper products will be reported in this department as they appear.

Fed. Std. No. 6 (New) Paper, Toilet Tissue; Price, 5 cents

This standard refers to Federal Specification UU-P-556 and covers two items of roll tissue and one of tissue in sheets, as follows:

FSSC 29-P-1020. Roll tissue, class 1, 1000 sheets per roll, 100 rolls per carton, unit of issue—carton, domestic packing.

FSSC 29-P-1020-25. Roll tissue, class 1, 1000 sheets per roll, 96 compressed rolls per carton, unit of issue—carton, V-board cartons.

FSSC 29-P-1023. Sheet tissue, doublefold, 100,000 sheets per carton (100 or 125 packages), unit of issue—carton, domestic packing.

Fed. Std. No. 8 (New) Paper, Blotting; Price 5 cents

This standard refers to Federal Specification UU-P-63 and covers two items of strip blotters for rocker-type holders and three items for use with desk pads, as follows:

FSSC 53-P-2520. 25% rag, 3 by 9½ in., white, 100 per package unit of issue—package, commercial packing.

FSSC 53-P-2525. 4 by 9½ in., otherwise same as FSSC 53-P-2520.

FSSC 53-P-2610. Chemical wood, 19 by 24 in., light green, 250 or 500 per package, unit of issue—sheet, commercial packing.

FSSC 53-P-2620. 24 by 38 in., otherwise same as FSSC 53-P-2610.

FSSC 53-P-2603. Brown, otherwise same as FSSC 53-P-2620.

Fed. Std. No. 7 (New) Towels, Paper; Price, 5 cents

This standard refers to Federal Specification UU-T-591 and covers two competitive items used as single-ply, two competitive items used as two-ply, and one item of roll towels, as follows:

FSSC 29-T-1096-750. Single-fold towels, single-ply, minimum width 9⅛ in., minimum area 100 sq. in., maximum depth of fold approx. 5½ in., 3750 per carton (25/15 packages), unit of issue—carton, domestic packing.

FSSC 29-T-1096-800. Same as above, but export packing.

FSSC 29-T-1010-5. Multifold towels, single-ply, minimum width 9⅛ in., minimum area 85 sq. in., maximum depth of fold approx. 3¼ in., 3750 per carton (25 packages), unit of issue—carton, domestic packing.

FSSC 29-T-1125. Same as FSSC 29-T-1010-5, except two-ply, area 65 sq. in.

FSSC 29-T-1096-500. C-fold towels, two-ply, minimum width 10⅛ in., minimum area 70 sq. in., maximum depth of fold approx. 4 in., 3750 per carton (25 packages), unit of issue—carton, domestic packing.

FSSC 29-T-1096-505. Same as FSSC 29-T-1096-500, except export packing.

FSSC 29-T-1140. Roll towels, single-ply, minimum width 11 in., minimum area 140 sq. in., 3750 per carton (25 packages), unit of issue—carton, domestic packing.

Single copies of this standard are available without charge at the GSA Regional Offices in Boston, New York, Atlanta, Chicago, Kansas City, Mo., Dallas, Denver, San Francisco, Los Angeles, Seattle, and Washington, D. C. Additional copies 5 cents each, from General Services Administration, Business Service Center, Region 3, Seventh and D Streets, S. W., Washington 25, D. C.

39th Annual Meeting

Technical Association of the Pulp and Paper Industry

Hotel Commodore, New York, N. Y.
Feb. 15–19, 1953

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UNITED STATES PATENTS ON PAPERMAKING

Second Quarter, 1953 — *Compiled by The Institute of Paper Chemistry*

The following list of United States patents has been compiled from the current numbers of the Official Gazette of the United States Patent Office. Because, as a rule, only one claim is published in the Gazette, it is not claimed that the list is complete; also, it is possible that the list may contain some patents that do not apply specifically to pulp and paper manufacture. Copies of any of the following patents may be obtained from the United States Patent Office, Washington 25, D. C., by sending twenty-five cents for each patent desired.

April 7, 1953

2,633,778. Removable grinding lining for jordan engines. Harold D. Stuck, assignor to John W. Bolton & Sons, Inc. Filed Nov. 27, 1948. 8 claims. (Cl. 92-27.) Removable abrasive members for a jordan plug and shell are slipped end to end into pockets along the inner surface of the shell or on the conical surface of the plug and are held in place by a low melting-point alloy.

2,633,779. Cleaning device for dandy rolls. Melvin D. Southworth, assignor to Southworth Co. Filed April 7, 1950. 12 claims. (Cl. 92-48.) A brush structure with bristles movable downward to clean the surface of a rotating dandy roll or upward out of engagement with it is mounted on a bracket on the paper machine.

2,633,780. Boxmaking machine. William R. Watson, assignor to Bird & Son, Inc. Filed March 22, 1951. 9 claims. (Cl. 93-49.) A machine is provided in which the setup box end is glued with the box in a horizontal position and the pressing operation is performed with the box at an angle of 30° to the horizontal, enabling the operator to grasp the boxes in the most effective way for handling.

2,633,979. Container for garments. Sam Warnick. Filed Dec. 16, 1948. 3 claims. (Cl. 206-7.) In a corrugated or cardboard shipping and storage container for garments (coats, dresses, etc.), vertical wooden posts stapled to the carton sides support a metal hanger rack extending across the top of the box.

2,633,982. Shipping package and pallet means. John S. Addison, assignor to Addison-Semmes Corp. Filed July 14, 1949. 2 claims. (Cl. 206–46.) A pallet for the shipment of furniture and adapted for use with a fork lift truck.

2,633,984. Tissue container. Vincent V. Jurzyniec. Filed Jan. 11, 1951. 10 claims. (Cl. 206-57.) A re-usable cardboard tissue container and dispenser formed from a single blank.

2,633,985. Cutter box roll carton. Edwin A. Meyer. Filed July 29, 1949. 1 claim. (Cl. 206-58.) A rectangular cardboard dispensing carton for wax paper comprises an upwardly opening box with a hinged cover infolded at its lower edge and coated with a metallic paint along this fold to form a cutting edge.

2,633,986. Package of triangular objects. Clarence W. Vogt. Filed Jan. 28, 1950. 1 claim. (Cl. 206-65.) Prismatic objects with triangular cross sections are packaged by placing their hypotenuses face to face with a liner interposed and extending beyond the ends of the block so formed. The liner ends are enclosed by the transparent or opaque sheet material used as a wrapper.

2,634,038. Container. Walter C. George and John A. Bousquet, assignors to Gaylord Container Corp. Filed March 25, 1952. 5 claims. (Cl. 229-14.) Tall, heavy-duty, rigid, corrugated paperboard containers for shipping and/or storing synthetic rubber blocks.

2,634,039. Molded pulp article. Walter J. Schwertfeger, assignor to Keyes Fibre Co. Filed June 10, 1947. 6 claims. (Cl. 229-15.) Molded-pulp egg cartons with top center closing for use in egg crates.

2,634,040. Foldable carton. Elmer A. Kaufman, assignor to Burroughs Adding Machine Co. Filed Dec. 7, 1949. 1 claim. (Cl. 229-16.) A carton for transporting or storing rolls of photographic film has a bottom and four connected side wall portions, two of which connect with two top portions adapted to overlap each other, permitting two different cover designs or labels.

2,634,041. Container construction. Edward N. Burnett, assignor to Gerber Products Co. Filed Feb. 20, 1951. 7 claims. (Cl. 229-23.) Individual corrugated box units mutually interlock in groups of three or more to provide a unitary box construction with separable cells for storing and/or transporting jars of baby food.

2,634,042. Cellular container for article shipping and storage. David H. Blatt and Frederic R. Mann. Filed April 12, 1949. 7 claims. (Cl. 229-28.) A single, cut and scored, corrugated paperboard blank is expanded into a cellular container with interlocking dividing partitions for yarn cones.

2,634,043. Article carrier. Edwin L. Arneson, assignor to Morris Paper Mills. Filed Nov. 13, 1951. 2 claims. (Cl. 229-28.) A one-piece paperboard bottle carrier has a multiple-ply longitudinal partition and handle panel from which the cross partition panels are cut. The handle is reinforced with additional plies from waste areas of the carton blank.

2,634,044. Carton. William P. Frankenstein. Filed Oct. 18, 1946. 17 claims. (Cl. 229-31.) A foldable cardboard box is set up from two blanks, one forming a complete outer box and the other, a partial inner liner. Used for shipping and displaying toys, the box can be reassembled when empty to form a toy building.

2,634,045. Box. Matthew A. Crinkley and Emery C. Swanson. Filed Sept. 27, 1947. 4 claims. (Cl. 229-31.) A hinged-top cardboard cake or pastry box designed to be set up by the consumer just prior to use, eliminates the usual tabs and slots and substitutes infolds and flaps which fold into place supporting the side wall.

2,634,046. Cardboard box structure. Morris M. Weber. Filed Aug. 10, 1950. 2 claims. (Cl. 229-34.) Inexpensive shallow handkerchief boxes constructed of bending chipboard with patent coating on the outside have a special reinforced side-wall construction to provide the necessary strength and stiffness.

2,634,062. Wood and brush chipping machine. William O. Forman, assignor to Fitchburg Engineering Corp. Filed Sept. 21, 1948. 9 claims. (Cl. 241-239.) A portable self-feeding chipping machine for use in logged areas comminutes brush, branches, and small trees (5-inch diameter) into easily transportable 4–5 inch chips.

2,634,139. Carbon pack for continuous-form stationery. Lester K. Fleischmann. Filed May 29, 1951. 2 claims. (Cl. 282-1.) An improved carbon pack has the rear ends of the carbon sheets stitched to the underside of the leader sheet in a typewriter providing a stronger connection than when the fold line and stitching line coincide.

2,634,207. Building board. Jack Miscall and Chester E. Rahr, assignors to Great Lakes Carbon Corp. Filed Dec. 31, 1947. 1 claim. (Cl. 92-3.) An insulating and building board comprising 25–90% by weight of cellulosic fibers and 10–75% expanded perlite in the form of discrete particles less than 20-mesh size.

2,634,208. Building board. Jack Miscall and Chester E. Rahr, assignors to Great Lakes Carbon Corp. Filed Dec. 31, 1947. 1 claim. (Cl. 92-3.) Process for making waterproof, fireproof, and high-wet-strength board.

2,634,209. Strainer for digesters. Leonard C. Nevin, assignor to Chemipulp Process, Inc. Filed May 19, 1948. 8 claims. (Cl. 92-7.) Digester strainer comprises a multiplicity of plates, interlocked so as to stiffen the strainer at the lines of interlocking, and strainer plate units thin enough to be flexible and mounted so as to move inwardly and outwardly preventing formation of scale deposits.

2,634,220. Coated paper. Benjamin J. Oriel. Filed Dec. 29, 1949. 1 claim. (Cl. 117-154.) Sheets of coated white paper for use with toy typewriters and erasable with water.

2,634,229. Sanitary napkin. Charl L. R. de Wet, assignor to International Cellucotton Products Co. Filed July 20, 1949. 9 claims. (Cl. 167-84.)

2,634,246. Resin for wet strength paper and process for making it. Harry E. Gronich, assignor to Allied Chemical & Dye Corp. Filed Nov. 13, 1950. 11 claims. (Cl. 260-29.4.) A urea-formaldehyde condensation product produced under well-controlled conditions that is selectively adsorbable from aqueous solutions by cellulosic fibers, which then yield papers of high wet strength.

2,634,247. Process for making resin for wet strength paper. Glenn A. Nesty and Harry E. Gronich, assignors to Allied Chemi-

cal & Dye Corp. Filed Oct. 6, 1951. 6 claims. (Cl. 260-29.4.) A modification of the process in U. S. patent 2,634,246 (cf. preceding patent).

April 14, 1953

2,634,563. Method of producing bulged containers. Donald G. Magill and Richard P. Bigger, assignors to American Can Co. Filed Dec. 13, 1950. 3 claims. (Cl. 53-11.) Single-ply, liquidproof, paperboard sidewalls for frozen-food containers are made to bulge by forcing them into metal-end units slightly smaller than the end dimensions of the sidewalls.

2,634,564. Machine for sealing the ends of wrapped articles. Samuel Bergstein. Filed Jan. 15, 1948. 4 claims. (Cl. 53-60.) A machine for sealing an erected and closed paperboard carton, wrapped in sheet material (paper, glassine, metal foil, etc.) and precoated with a thermoplastic adhesive. With the ends of the wrapper still open, heat-softened, thermoplastic material is deposited directly on the carton ends and the wrapper folded down on it insuring a moistureproof and gastight seal.

2,634,565. Carton closing and printing device for cartoning machines. John F. Currivan, assignor to Emhart Manufacturing Co. Filed Jan. 12, 1949. 21 claims. (Cl. 53-60.) Means for printing information upon the ends of lightweight cardboard cartons are combined with a power-driven closing device; closure results from a wiping engagement of the rollers with the flaps.

2,634,566. Apparatus for bottom closing paperboard containers. Rudolph E. Ohrn, assignor to Container Corp. of America. Filed Nov. 15, 1950. 10 claims. (Cl. 53-145.) The apparatus comprises a roller conveyor of four sections with longitudinally spaced gaps, constructed to fold (or permit the folding of) both the inner and outer bottom closure flaps of a paperboard container.

2,634,658. Apparatus for manipulating breast rolls. Paul A. Fasoli, assignor to The Sandy Hill Iron & Brass Works. Filed April 13, 1949. 5 claims. (Cl. 92-44.) The apparatus is constructed to support the breast roll rotatably and move it from operating position for removal of the fourdrinier wire.

2,634,797. Hassock and method of making same. Earl C. Wallace, assignor to The Hettrick Manufacturing Co. Filed Sept. 1, 1950. 8 claims. (Cl. 155-169.) A chest-type hassock has double walls of corrugated paperboard enclosing wooden braces which re-enforce the top and bottom edges.

2,634,854. Container for cigarettes and matches. Donald V. Brandt and Sterling R. Cheek. Filed Aug. 30, 1951. 2 claims. (Cl. 206-48.) A lightweight paperboard container is designed to hold a pack of standard size cigarettes. Safety matches are carried on the front and back of the container and a match-striking pad is mounted on the side.

2,634,855. Tissue dispensing device. Jacob Mandel. Filed Sept. 4, 1951. 3 claims. (Cl. 206-57.) A transversely hinged flat piece of cardboard under the stack of tissues in a dispenser is kept under tension, forcing the tissues upward by means of a rubber band secured in the notched sides of the carboard as the upper layers are removed.

2,634,856. Sterile pack for individual disassembled syringes. John J. Perkins, assignor to American Sterilizer Co. Filed March 14, 1952. 1 claim. (Cl. 206-63.2.) The disassembled syringe (with the needle in a gauze scrub) is placed in a steam-pervious paper bag for sterilization; upon removal from the autoclave the contents of the pack remain sterile until the bag is opened for use.

2,634,876. Package sealing machine. James R. Flanagan, assignor to Stephen F. Whitman & Sons. Filed Jan. 12, 1951. 11 claims. (Cl. 216-21.) Paperboard cartons move from the packing belt, between guide rails, along a table and are automatically sealed with adhesive or gummed paper by positioned applicators.

2,634,895. Knockdown carrier. William A. Ringler, assignor to The Gardner Board and Carton Co. Filed Nov. 20, 1947. 2 claims. (Cl. 229-15.) A collapsible paperboard bottle carrier is fully partitioned and has a detachable wire handle whose ends pass through slots in the center wall of the carrier.

2,634,896. Container. John C. Graveno, assigned one half to Joseph E. Stern. Filed Jan. 14, 1950. 2 claims. (Cl. 229-17.) Square milk bottles of foldable moistureproof material are closed at the top with a staple member and are provided with integrally formed, collapsible, spoutlike closing and discharge portions.

2,634,897. Pouring spout for cartons. Max Bord. Filed Oct. 18, 1947. 1 claim. (Cl. 229-17.) The spout is an integral part of the paperboard carton and its hinged connection to the carton permits it to be opened 90° without strain. Adjoining, supporting flaps provide a sealed closure on all four sides when the spout is closed.

2,634,898. Collapsible cellular carton. William H. Inman, assignor to Bloomer Bros. Co. Filed Aug. 2, 1946. 3 claims. (Cl. 229-28.) Cellular egg cartons are made from one-piece cardboard blanks, cut, scored, and glued for folding and a hinged top is attached to the rear side.

2,634,899. Glueless interlock for folding box panels. Reginald R. Meller, assignor to Bemiss-Jason Co. Filed April 17, 1948. 4 claims. (Cl. 229-35.) Glueless paperboard cartons are maintained in position by the interengagement of the panels or flaps constituting the box blank. An edge-to-edge interlock between the flaps is supplemented by corner-lock tabs.

2,634,900. Folding box or carton. David Levkoff. Filed Nov. 1, 1949. 6 claims. (Cl. 229-41.) Two different forms of folding traylike cartons from single scored and cut cardboard blanks differing only in the end construction.

2,634,901. Cement sack or the like. Reuben Berglund. Filed Aug. 23, 1947. 5 claims. (Cl. 229-53.) A multi-layer paper bag for cement, sand, etc., has a weight-carrying side wall comprising a loop of cord, disposed between layers of the wall, with its end portions exposed to provide handles.

2,635,045. Making elastomer containing paper. Andrew L. M. Bixler and Jacob I. Fisher, assignors to Riegel Paper Corp. Filed April 21, 1948. 15 claims. (Cl. 92-21.) A tough, pliable sheet of paper with high initial tear strength and 20–50% elastomeric materials incorporated in it can be made from bleached or unbleached kraft, sulphite, soda, semichemical, groundwood, rag, rope, or jute pulps.

April 21, 1953

2,635,301. Web or mat forming device. Dale L. Schubert and Albert H. De Meerleer, assignors to Plywood Research Foundation. Filed Sept. 30, 1948. 3 claims. (Cl. 19-156.) A device for air formation of mechanically defibered lignocellulose materials such as straw, sugar cane, cornstalks, or wood fibers into a web or mat.

2,635,508. Apparatus for forming cement sheets. Alessandro Magnani. Filed Feb. 27, 1948. 6 claims. (Cl. 92-44.) This is a continuation-in-part of U. S. patent 2,592,518 (April 8, 1952).

2,635,509. Method of processing paper. Ira C. Cowie and Jasper H. Purcell, assignors to Glassine Paper Co. Filed Oct. 26, 1946. 9 claims. (Cl. 92-68.) Glassine and greaseproof papers can be made with dissimilar surface characteristics by running two or more sheets through a modified supercalender.

2,635,510. Apparatus and method for attaching handles to bags. Frank A. Grant, assignor to Paper Strap, Inc. Filed July 19, 1947. 19 claims. (Cl. 93-8.) A machine for attaching strap handles to paper bags, cartons, and the like. The straps are cut from a continuous strip of paper to predetermined lengths, folded, coated with adhesive at each end, and attached to the bag ends.

2,635,511. Apparatus for making sacks. Adolph Potdevin, assignor to Potdevin Machine Co. Filed April 27, 1948. 12 claims. (Cl. 93-23.) A machine for making paper sacks consisting of a paper body and a chipboard bottom.

2,635,512. Machine for making fibrous boxes. Charles B. Harker, assignor to Clybourn Machine Corp. Filed Jan. 31, 1951. 19 claims. (Cl. 93-37.) A machine which continuously and automatically forms fibrous boxes from die-cut blanks.

2,635,537. Paper planographic printing plate with stabilized hydrophilic coating. Stephen V. Worthen, assignor to S. D. Warren Co. Filed July 19, 1950. 16 claims. (Cl. 101-149.2.) A paper-base planographic printing plate made by the application of a coating of mineral filler and a hydrophilic adhesive; a multivalent metal salt and a uni-univalent salt are used to fill the interstices of the coated surface. This is a further amplification of U. S. patent 2,534,650 (Dec. 19, 1950).

2,635,562. Haystack cover. Elmer D. Abramson, assignor to Central States Paper & Bag Co. Filed March 13, 1950. 6 claims. (Cl. 108-3.) Two plies of high tensile-strength paper stock secured together by a layer of asphaltic adhesive comprise a tarpaulin-like haystack cover.

2,635,695. Sheet feeding mechanism. Robert J. Thompson, assignor to The W. O. Hickok Mfg. Co. Filed June 9, 1947. 25 claims. (Cl. 164-87.) The machine gathers a predetermined number of sheets, registers the assembled pack, and then feeds it through a perforator.

2,635,774. Paper roll handling mechanism. E. Ryan Backofen and Alfred W. Gunning, assignors to Clark Equipment Co. Filed June 23, 1949. 9 claims. (Cl. 214-652.) A lift truck is equipped with a rotatable paper roll handling mechanism, which can be rotated 90° so that rolls may be stacked vertically or horizontally.

2,635,802. One-piece fiberboard shipping container. Samuel P. Belsinger, assignor to Belsinger, Inc. Filed Dec. 15, 1949. 1 claim. (Cl. 229-16.) A tall upright fiber or corrugated-board container with front opening is designed for easy packing of low-density materials (e.g., bolts of knitted cloth).

2,635,803. Valve bag. Carl H. Hartman, assignor to St. Regis Paper Co. Filed May 2, 1950. 4 claims. (Cl. 229-62.5.) A valve of the "tuck-in" sleeve type designed for use in multiwall paper bags.

2,635,872. Means for feeding lengths of material between series of rollers. James Birse. Filed April 10, 1950. 3 claims.

(Cl. 271-2.3.) Hand feeding of material between a series of rollers (as in a calender stack) is eliminated by arranging an endless-feed belt unit and pulleys on the intake side of each pair of adjacent rollers. A swivel guide roller in front of the leading pulley inserts the end of the material.

2,635,958. Method of producing porous paper. Daniel S. Dieffenderfer, assignor to Riegel Paper Corp. Filed April 14, 1949. 3 claims. (Cl. 92-21.) A porous paper suitable for use as vacuum cleaner bags consists of a mixture of leather fibers and long cellulose fibers.

2,635,968. Etherified lignocellulose, etherified lignocellulose containing products, and method of making the same. Earl G. Hallonquist, assignor to Plywood Research Foundation. Filed June 15, 1948. 26 claims. (Cl. 106-200.)

2,635,970 Translucent paper base. Martin Salo and Harold F. Vivian, assignors to Eastman Kodak Co. Filed Nov. 26, 1948. 2 claims. (Cl. 117-86.) A translucent paper (sulphate, sulphite, rag, cotton, linen, hemp, or rope stock) base for photographic uses is prepared by the hot-melt impregnation of a water-leaf sheet with cellulose acetate butyrate and chlorinated diphenyl. A coating of cellulose acetate butyrate plasticized with dibutyl sebacate and butyl stearate is then applied.

2,635,972. Coated paper and process for making same. Julian L. Azorlosa and Donald P. Hug, assignors to Hercules Powder Co. Filed Feb. 3, 1950. 14 claims. (Cl. 117-157.) A paper web is treated with a carboxymethyl hydroxyethyl cellulose by immersing, then passing between rolls to remove the excess with a significant increase of wet and dry strength of the treated paper.

2,636,028. Organic acid-polyamine adducts. Harry J. Sommer, Tom B. Albin, and Paul H. Williams, assignors to Shell Development Co. Filed March 24, 1950. 20 claims. (Cl. 260-97.5.) A tall oil compound useful for sizing and coating paper produced by heating epichlorohydrin in aqueous solution containing at least 15% ammonia, removing the water and heating with alkali.

April 28, 1953

2,636,297. Price marking label having pressure-sensitive adhesive thereon. Floyd K. Johnson, assignor to The Monarch Marking System Co. Filed June 29, 1950. 2 claims. (Cl. 40-2.) Price marking labels with pressure-sensitive adhesive backing are processed in continuous strip form with lines of weakening between labels.

2,636,312. Carton adaptable for conversion to toys. Ronald H. Martin. Filed Feb. 24, 1949. 3 claims. (Cl. 46-11.) A phonograph record container which may be converted to a toy for mounting on a phonograph turntable; the converted paperboard carton, suitably printed and assembled, resembles a merry-go-round.

2,636,313. Combination ice cream carton and toy. Clarence S. Shank, assignor 50% to Robert Critchfield. Filed June 10, 1950. 5 claims. (Cl. 46-11.) An ice cream carton blank printed with the designs for three-dimensional toy buildings.

2,636,422. Pulp molding apparatus having a forming device and a spring-actuated flexible permeable structure. Georges Pierson. Filed Aug. 6, 1947. 3 claims. (Cl. 92-57.) An apparatus for forming articles from molded pulp consists of a spring-activated, flexible, permeable form which may be collapsed after the article is molded to facilitate the stripping of the mold from the damp rough.

2,636,423. Machine for making partitions. Donald F. Cunningham, assignor to American Partition Corp. Filed March 24, 1948. 20 claims. (Cl. 93-97.) A machine which makes container partitions for such items as bottle cells from paper, chipboard, cardboard, etc.

2.636,599. Dispensing carton. Cecil H. Willis and Ronald Williams, assignors to Kalamazoo Vegetable Parchment Co. Filed Sept. 10, 1951. 9 claims. (Cl. 206-57.) A false bottom is provided in a carton for dispensing tissue or other sheet material. After a portion of the contents has been withdrawn, supporting struts are employed to support the false bottom, thereby raising the contents to a more accessible position.

2,636,600. Thermometer package. Charles B. Denton and George A. Terhune, Jr., assignors to Weston Electric Instrument Corp. Filed May 22, 1950. 3 claims. (Cl. 206-65.) A shipping and storage container which holds individual thermometers or like articles in a fixed position in the carton by utilizing two or more perforated spacers protruding through slots in the platform.

2,636,660. Molded pulp carton. Lile H. Brown, assignor to Shellmar Products Corp. Filed March 24, 1947. 3 claims. (Cl. 229-15.) The double rows of cells in this molded pulp egg carton are in a staggered relationship to each other. Such an arrangement provides ample room in the lid for large eggs and still allows the use of sloping side walls in the molding process.

2,636,661. Egg carton. John W. Cox, assignor to Shellmar Products Corp. Filed April 15, 1949. 5 claims. (Cl. 229-28.) A foldable paperboard setup-type egg carton.

2,636,662. Utility case. Philip A. Diehl, assignor to The Norwalk Paper Box Co. Filed Nov. 10, 1949. 2 claims. (Cl. 229-44.) A paperboard or fiberboard case whose base and cover are each formed from a single blank, are joined by a heavy wire, piano-type hinge.

2,636,663. Wire handled basket. William E. Hauck, assignor to Inland Container Corp. Filed Nov. 10, 1951. 2 claims. (Cl. 229-52.) This invention relates to the mode of attachment of a wire handle to small corrugated-board vegetable and fruit baskets.

2,636,730. Web feeding means for container forming apparatus. Lewis B. Eaton, assignor to Pneumatic Scale Corp., Ltd. Filed March 30, 1948. 9 claims. (Cl. 271-2.6.) A machine (in duplex form) for packaging with heat-sealable printed paper (i.e., tea-bagging) from a continuous web.

2,636,731. Web feeding means for container forming apparatus. Stanley R. Howard, assignor to Pneumatic Scale Corp., Ltd. Filed March 30, 1948. 14 claims. (Cl. 271-2.6.)

2,636,732. Web feeding method and means for container forming apparatus. Stanley R. Howard, assignor to Pneumatic Scale Corp., Ltd. Filed March 30, 1948. 16 claims. (Cl. 271-2.6.)

2,636,733. Method and means for feeding blanks. Arthur J. Lewis, assignor 50% to Ex-Cell-O Corp. and 50% to a group comprising Ace C. Fessenden and Ace Carton Corp. Filed Sept. 20, 1948. 17 claims. (Cl. 271-23.) A feed mechanism for the removal of carton blanks from the bottom of a pile. Picker fingers on opposite sides of the pile engage the bottom blank which is bent downward and separated from the pile.

2,636,813. Apparatus for burning waste liquor. John C. Singleton, Jr., assignor to The Babcock & Wilcox Co. Filed May 2, 1947. 5 claims. (Cl. 23-277.) A furnace with two or more discharge nozzles directed downward at such an angle that a combustion zone is maintained just above the hearth provides an efficient means of chemical and heat recovery from waste liquors.

2,636,833. Method of producing supercalendered plasticized glassine paper. George C. Borden, Jr., assignor to Riegel Paper Corp. Filed Nov. 7, 1952. 3 claims. (Cl. 117-65.) Supercalendered glassine to which invert sugar has been added as a plasticizer is cooled by air jets before winding on the reel.

2,636,838. Method of producing a flat moistureproof paper lamination. Russell H. Savage, assignor to The Mead Corp. Filed April 14, 1947. 10 claims. (Cl. 154-138.) An interlayer of wax is used to prevent curling of coated-one-side paper.

May 5, 1953

R23,650. Rechipper with vibrating trough. Einar I. Flateboe, assignor to Sumner Iron Works. Filed Nov. 3, 1952. 10 claims. (Cl. 241-92.) This is a continuation of U. S. patent 2,582,537 (issued Jan. 15, 1952).

2,637,250. Papermaking apparatus. Benjamin E. Teale. Filed June 21, 1950. 3 claims. (Cl. 92-44.) The slice construction described for use with a fourdrinier paper machine employs transversely spaced elongated horizontal side plates and features adjustability so that it may be positioned as desired relative to the headbox.

2,637,357. Hand-guided and chain-driven bark-removing tool. Louis W. Johnson and William G. Saunders. (Saunders' interest assigned to Johnson.) Filed Aug. 30, 1951. 4 claims. (Cl. 144-208.) A log peeler for use on logs with thick bark. Traction chains in the wedge-shaped head force the head under the bark; power is provided by a motor mounted on the handle.

2,637,439. Soap package. Millard S. Banks. Filed Feb. 16, 1949. 1 claim. (Cl. 206-47.) A package that contains sufficient soap product for a single use is designed for vending-machine distribution along with a disposable towel.

2,637,476. Can carrier. Frederic D. Empkie, Jr., assignor to Container Corp. of America. Filed Aug. 24, 1950. 2 claims. (Cl. 224-45.) A portable can carrier of paperboard formed from a single die-cut blank in which the cans are held in a double row, separated by a medial partition.

2,637,479. Egg carton. John W. Cox, assignor to Shellmar Products Corp. Filed March 28, 1947. 1 claim. (Cl. 229-2.5.)

2,637,480. Paperboard carrier. Homer W. Forrer, assignor to Atlanta Paper Co. Filed Oct. 2, 1950. 6 claims. (Cl. 229-27.) A paperboard carrier of completely enclosed design, the cover of which lends itself to novelty arrangements.

2,637,481. Display carton for fruits and vegetables. Carl Adams, Sr. Filed July 5, 1949. 3 claims. (Cl. 229-30.)

2,637,482. One-piece covered container. Frank W. Broderick, assignor to Berles Carton Co. Filed July 15, 1950. 7 claims. (Cl. 229-30.) This carton, whose tray and lid are stamped from one piece of cardboard, permits visual inspection of the contents such as globular fruits and vegetables.

2,637,483. Folded blank box. David H. Shapiro. Filed July 28, 1951. 3 claims. (Cl. 229-31.) A box which may be easily set up with automatic box-blank, folding, and gluing machines without staples or metal stitching.

2,637,484. Collapsible carton. Kenneth T. Buttery, as-

signor to Sutherland Paper Co. Filed Aug. 19, 1949. 3 claims. (Cl. 229-34.) This carton is designed for the shipping of heavy materials.

2,637,627. Process for preparing raw sulphite acid. Gustaf Haglund. Filed Aug. 5, 1947. 4 claims. (Cl. 23-130.) A sulphur dioxide adsorption apparatus for the continuous production of raw sulphite acid.

2,637,629. Roasting sulphide ores. Warren K. Lewis, assignor to Standard Oil Development Co. Filed June 2, 1947. 8 claims. (Cl. 23-177.) A method for producing from sulphide ores, particularly pyrites, sulphur dioxide substantially free from sulphur trioxide, free oxygen, and elemental sulphur, and leaves the metal sulphide substantially free of sulphur.

2,637,630. Method of burning sulphur. Gaines N. Houston, assignor to Mathieson Chemical Corp. Filed July 6, 1948. 3 claims. (Cl. 23-179.) A method of producing very pure sulphur dioxide and vapor-phase sulphur from commercial-grade sulphur.

2,637,650. Fiberboard containing bitumen modified fatty acid pitch. Leonard C. Bradshaw, assignor to International Bitumen Emulsions Ltd. Filed May 6, 1952. 3 claims. (Cl. 92-3).

2,637,657. Thermosensitive papers and compositions therefor. Karlis V. Ozols, assignor to Product Development Laboratories, Inc. Filed June 10, 1946. 6 claims. (Cl. 106-178.) The thermosensitive coating composition comprises 60–80% of a lead organic acid salt (e.g., lead formate), 5–30% of a mercury organic acid salt (mercuric oxalate), and 2–15% of a binder (ethylcellulose).

2,637,660. Process of coating. Miles G. Bigley, assignor to Koppers Co., Inc. Filed Dec. 20, 1945. 4 claims. (Cl. 117-66.) A process for and the equipment for saturating building paper with coke-oven tar containing naphthalene.

2,637,661. Fungicidal composition and process of using same. Paul G. Benignus, assignor to Monsanto Chemical Co. Filed March 28, 1945. 3 claims. (Cl. 117-103.) Textiles, cordage, paper, wood, etc., are protected from attack by fungi and mold by impregnating them with an aqueous solution containing copper-, cadmium-, or zinc-ammonium ions, a water-soluble pentachlorophenate in the presence of a water-miscible organic solvent for the metal pentachlorophenate, and an alkylated methylol compound of melamine or urea.

2,637,665. Impregnated paper and method of making same. Lloyd L. Dodge, assignor 50% to Highland Manufacturing Co. Filed July 20, 1950. 2 claims. (Cl. 117-158.) Process for making a moisture- and greaseproof paper which is suitable to receive printing inks.

2,637,674. Preparation of impregnated laminated tubes. William F. Stahl. Filed Aug. 31, 1946. 4 claims. (Cl. 154-83.) Thermosetting resin impregnated paper strips are bonded by high frequency current and pressure to cause resin flow.

2,637,675. Process for preparing laminated bodies of cellulosic materials and product. Walter N. Bain, assignor to The Glidden Co. Filed March 7, 1952. 18 claims. (Cl. 154-138.) A water-resistant laminated paperboard can be manufactured by applying to at least one surface of an alum-treated paper ply an aqueous film of quick-setting proteinaceous adhesive.

2,637,766. Metallized paper capacitor. Richard A. Grouse, assignor to A. H. Hunt Capacitors Ltd. Filed Jan. 11, 1949. 7 claims. (Cl. 175-41.) An apparatus and method for the manufacture of a printed metallized paper strip; the strip is wound into a roll to form an electrical capacitor of small size.

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2,637,915. Apparatus for treating pulp and resin mixtures. Alexander C. H. Weiss. Filed May 6, 1948. 2 claims. (Cl. 34-57.) An apparatus for dewatering and drying a mixture of kraft pulp and resin for injection molding consists of a dewatering drum from which the pulp mat is doctored, press rolls, a spiked roll for fluffing and fragmentizing the mat, and a baffled tunnel through which the pulp is conveyed by a blast of hot air.

2,637,958. Flap opener for cartons. Arthur W. Lippmann and Edmund E. Lippmann, assignors to Lippmann Engineering Works. Filed July 31, 1951. 3 claims. (Cl. 53-24.)

2,637,961. Package wrapping apparatus. James M. Sutton. Filed Nov. 1, 1949. 17 claims. (Cl. 53-149.) An apparatus designed to perform only that part of package wrapping concerned with the end closure of the overwrap.

2,637,996. Method and apparatus for testing paperboard. Robert C. McKee and George R. Sears, assignors to The Institute of Paper Chemistry. Filed Sept. 9, 1948. 6 claims. (Cl. 73-96.) Method and apparatus for determining the continued tear resistance of paperboard or corrugated board.

2,638,037. Apparatus for feeding webs. Cutler D. Knowlton, assignor to Hoague-Sprague Corp. Filed Aug. 29, 1947. 11 claims. (Cl. 93-36.6.)

2,638,146. Reinforced paper and method and apparatus for the manufacture thereof. Ellsworth A. Rounseville and Ralph G. Estee, assignors to Glas-Kraft, Inc. Filed Jan. 7, 1949. 27 claims. (Cl. 154-1.76.) Method and apparatus for manufacturing a laminated sheet with glass-fiber reinforcing.

2,638,208. Book matches with ejection-type ignition means therefor. Melvin H. Olsen. Filed July 12, 1951. 5 claims. (Cl. 206-34.) Disposable cardboard match packet consists of a magazine from which the match is ejected with the thumb, the match being lighted in the ejection process by opposing abrasive-coated surfaces.

2,638,210. Display box for decorated Easter eggs. George C. Sparks. Filed Oct. 20, 1949. 1 claim. (Cl. 206-45.14.)

2,638,211. Label package and dispenser. Winfred F. Spurr, assignor to Ace Art Co. Filed July 10, 1951. 3 claims. (Cl. 206-57.) Cardboard label dispenser consisting of a box with a slotted top or end and fitted with a spring arrangement in the bottom of the carton which is formed from a piece of the carton blank folded in an accordion fashion.

2,638,212. Package of flat articles with adjustable filler pad. Fred O. Robertson, assignor to Borg-Warner Corp. Filed Dec. 3, 1951. 2 claims. (Cl. 206-65.) A method for packaging long flat articles (e.g., handsaws) in standard-size boxes.

2,638,261. Frozen food carton with plastic lid. William J. Poole, assignor to Container Corp. of America. Filed May 10, 1948. 6 claims. (Cl. 229-5.5.) A transparent plastic lid forms a wedgelike, liquidtight seal with the upper edge of the reusable, waxed-paperboard carton.

2,638,262. Carton. Ersel Mulnix. Filed June 18, 1949. 6 claims. (Cl. 229-39.) This fiberboard carton has a gabled-roof structure and an integral handle.

2,638,415. Production of cellulose. John E. Jones and Reginald R. Stott, assignors to Celanese Corp. of America. Filed Dec. 27, 1948. 9 claims. (Cl. 92-11.) Cellulose produced from raw lignocellulosic material by impregnating the material with a 2–5% aqueous solution of caustic alkali, lowering and raising the temperature for specified intervals, and then subjecting the material to a delignifying treatment.

2,638,421. Process of agglomerating particles of wood. Jean P. J. Serres. Filed April 6, 1949. 11 claims. (Cl. 106-163.) A method for the molding of panels or other objects from pulp, shavings, fibers, or certain vegetable fibers with sulphur-containing organic compounds.

2,638,459. Method of preparing petroleum wax compositions containing a small amount of polyethylene. John R. Bowman, William P. Ridenour, and June H. Whittaker, assignors to Gulf Research & Development Co. Filed Dec. 4, 1950. 9 claims. (Cl. 260-28.5.) Petroleum-wax compositions with improved tensile strength are obtained by the introduction of high molecular-weight ethylene polymers.

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2,638,638. Floor covering and felt base material. Eugene B. McBride, assignor to Sloane-Blabon Corp. Filed April 4, 1950. 4 claims. (Cl. 20-7.) A barrier coat is applied to the felt base prior to impregnation so that the base felt splits for easy removal of the linoleum, etc.

2,638,725. Paper roll wrapping machine. Alfred T. Hurter and Andre C. Attendu, assignors to Stadler, Hurter & Co. Filed May 12, 1950. 26 claims. (Cl. 53-59.) The body wrapper for large paper rolls such as newsprint is applied from a roll of wrapping paper mounted on the machine, and as the roll of newsprint is rotated, the edges are automatically crimped and glued.

2,638,819. Diaphragm control for press roll assemblies. Lloyd Hornbostel, assignor to Beloit Iron Works. Filed March 18, 1948. 6 claims. (Cl. 92-49.) Fluid pressure is applied to both ends of a roll assembly through diaphragms containing mechanical linkage for adjustment.

2,638,820. Cylindrical container and method of making same. Thomas F. Barnes. Filed July 1, 1947. 2 claims. (Cl. 93-39.1.) Fiberboard drums formed from flexible paperboard plies.

2,638,821. Blank forming press feed. John R. Baumgartner. Filed July 12, 1950. 5 claims. (Cl. 93-58.) The press-feeding mechanism consists of a pair of intermittently active feed rolls which, in turn, are supplied by a pair of continuously active metering feed rolls.

2,638,962. Machine for making corrugated paper. Charles D. Nitchie, assignor to Samuel M. Langston Co. Filed Feb. 24, 1951. 9 claims. (Cl. 154-31.) This single-faced corrugator features an endless belt for holding the corrugated and facing sheet together until the adhesive has had time to set.

2,639,028. Garment bag. Walter Stern, assignor to The Cromwell Paper Co. Filed Nov. 3, 1949. 5 claims. (Cl. 206-7.) A dust- and mothproof garment bag of the type used by dry cleaning establishments.

2,639,079. Multiple cell carton. Noel A. Petter. Filed April 28, 1950. 8 claims. (Cl. 229-28.) Carton for packaging eggs.

2,639,080. Folding box. Wilbur G. Anderson, Jr., assignor to American Box Board Co. Filed Oct. 31, 1949. 1 claim. (Cl. 229-38.) A box cut from a minimum of sheet material is pro-

vided with ears for locking the carton in the closed position and is easily folded from the flat blank into the finished box.

2,639,081. Article holding insert for cartons. Henry L. Metzger. Filed Oct. 6, 1949. 1 claim. (Cl. 229-42.) An insert designed to hold irregularly shaped articles (spoons, etc.) in position within a carton.

2,639,082. Container structure with handle attachment. Albert J. Goldsmith. Filed May 26, 1948. 1 claim. (Cl. 229-52.) A container of relatively flat construction having telescoping end and top walls with attached handle.

2,639,104. Roll holder. Bernard A. Gustafson and John N. Wahlbeck. Filed Feb. 9, 1949. 7 claims. (Cl. 242-139.) A machine for trimming the marginal edges of roll paper, particularly wallpaper or like material.

2,639,150. Skid lift. Roy Aberle, assignor to Southworth Machine Co. Filed Dec. 15, 1947. 3 claims. (Cl. 271-62.) A phototube and light source are coupled to a motor-driven lifting device, so that paper or other sheet material is always maintained at the most convenient height for the operator.

2,639,212. Pan liner. Paul Thompson, asignor to Bestpak, Inc. Filed June 7, 1950. 1 claim. (Cl. 8-120.) Sheets of kraft, sulphite, or alpha pulp are treated with acetic or benzoic anhydride in glacial acetic acid and reacted at a temperature under 40°C. Treatment with 2–5% polyvinyl alcohol in water imparts added grease resistance. Sheets treated in this manner will not adhere to the product or the pan.

2,639,242. Acid-resistant wet-strength paper. Tzeng-Jiueq Suen, assignor to American Cyanamid Co. Filed Aug. 14, 1950. 1 claim. (Cl. 117-155.) A phenol-formaldehyde resin is used as a beater additive to unbleached kraft, rags, soda, etc., to make a paper which retains its strength under acid conditions.

May 26, 1953

2,639,483. Device for guiding weblike material. Karl G. Wester, assignor to A B Svenska Fläktfabriken. Filed Oct. 23, 1950. 3 claims. (Cl. 26-54.) Two or more spirally threaded rolls or brushes are mounted on guide arms adjustable transversely to the web feed into the drying machine.

2,639,567. Universal packaging machine. John P. Murdoch and Albert J. Faulhaber. Filed March 13, 1950. 45 claims. (Cl. 53-40.) A machine capable of detecting the edges of irregularly shaped articles (meat products) and wrapping these articles with a heat-sealable material such as Pliofilm, is controlled by a series of photocell stations.

2,639,646. Apparatus for shaping tampon applicator tube ends. Oscar T. Thompson and Howard M. Ruth, assignors to International Cellucotton Products Co. Filed Dec. 2, 1948. 3 claims. (Cl. 93-36.5.) The machine described receives plain cylindrical tubes of paperboard and performs two operations; one end is smoothed and rounded, the other starred or corrugated to form a tapered end portion.

2,639,647. Battery insulator tube manufacture. Henry J. Berenson, assignor to National Paper Can & Tube Co. Filed Feb. 23, 1949. 23 claims. (Cl. 93-36.5.) A cardboard tube is cut from a long section and an expansible mandril is inserted; the bottom of the tube is crimped by a curling tool and a rotating tool forms the expanded shoulder over the expansible mandril.

2,639,648. Carton setup machine. Richard J. Fahey, assignor to Shellmar Products Corp. Filed Sept. 28, 1946. 32 claims. (Cl. 93-37.) A machine for rapidly setting up collapsed paperboard-type egg cartons.

2,639,689. Paste applicator for wrapping paper. Louis Derr, Jr. Filed July 27, 1950. 2 claims. (Cl. 118-415.) A tank containing paste or other adhesive rests on the rearward edge of a stack of precut wrapping paper. As the top sheet is removed from the pile, paste from the tank is spread across the rear edge of the sheet.

2,639,649. Box staying machine. Martin V. Silby. Filed Dec. 5, 1947. 3 claims. (Cl. 93-41.) A means is provided for the accurate alignment of box blanks which have been previously folded; an adhesive-coated paper binder is then applied to the corners of the boxes while these are held rigidly with an anvil supporting the inside cover.

2,639,771. Combination envelope opener and paper sheet cutter. Victor Kobler and Werner Kobler. Filed May 31, 1950. 2 claims. (Cl. 164-59.) The provision of a hinged stop makes possible the dual use of the apparatus. With the stop in position, only a narrow edge is cut from the envelope; but with the stop swung out of the way, the instrument becomes a small paper cutter.

2,639,806. Combination package. Sidney Recht. Filed June 20, 1950. 2 claims. (Cl. 206-47.) The cover of the carton is formed in such a manner that it holds a dropper bottle (as used for medicinal preparations), and the dropper bulb protrudes through the cover.

2,639,807. Shipping package for press inking rolls. Louis C. Ambrette and John W. McNeil. Filed Dec. 24, 1949. 2 claims. (Cl. 206-65.) Paperboard or corrugated board inserts are placed in each end of this shipping package to hold the rolls in a suspended position within the carton. The inserts are punched in such a manner that the shaft of the roll projects through, and a shoulder on the shaft positions the insert in the carton.

2,639,854. Box. Benjamin L. Thurston, assignor to Frost Box Co., Inc. Filed Nov. 20, 1951. 1 claim. (Cl. 229-14.) A liner strip for insertion into the lid of telescoping boxes for adjusting the amount of overlap. The width of the strip governs the amount that the top may overlap the bottom section.

2,639,916. Timed feeding device for carton blanks. Russell W. Anness, assignor to The Gardner Board and Carton Co. Filed July 19, 1949. 7 claims. (Cl. 271-35.)

2,639,986. Method in sulphite pulping for obtaining concentrated waste liquor. Gunnar Kyrklund, assignor to Kymin Osakeyhtiö-Kymmene Aktiebolag. Filed Sept. 3, 1947. 3 claims. (Cl. 92-11.) A two-stage sulphite pulping procedure in which the spent liquor withdrawn from one cook is fortified with a suitable base and sulphur dioxide and used for the precook stage in the next cook. Upon withdrawal from the digester, the spent liquor contains approximately twice the amount of organic solids found in the spent liquor from the one-stage cook.

2,639,987. Two-stage pulping process. Arthur R. Sloman, assignor to Associated Pulp and Paper Mills Ltd. Filed June 15, 1948. 1 claim. (Cl. 92-13.) Pulping of eucalyptus wood is accomplished in two stages, with the consumption of less caustic and in the same amount of time as required for a single-stage cook.

2,639,988. Production of textile fibers from bast fiber material by alkaline digestion. Jacob J. Zeehuisen. Filed Dec. 12, 1945. 7 claims. (Cl. 92-14.)

2,639,989. Treatment of cellulosic pulps. James H. Conover, assignor to United States Gypsum Co. Filed April 25, 1946. 7 claims. (Cl. 92-21.) The addition of an alkaline earth hydroxide such as lime hydrate causes rapid drainage of hydrated pulp; this permits the manufacture of dense board products from hydrated fiber in existing equipment.

2,639,994. Process for manufacturing composite board. Winfred E. Wilson. Filed July 26, 1948. 1 claim. (Cl. 106-163.) A process for the production of composite board from such ligneous materials as wood shavings, coarse sander dust, or mechanically defibered wood.

2,640,000. Flameproofing method and product. Leslie P. Seyb and Clifford A. Neros, assignors to Diamond Alkali Co. Filed June 7, 1947. 8 claims. (Cl. 117-76.) A flame-retarding and water-repelling substance, such as antimony oxide, and a chlorinated paraffin are adapted to co-act in a flame-retarding relationship when exposed to flame temperature upon a fibrous or fabric base.

2,640,052. Alkali-lignin tanning agents and method of preparation. William B. Stoddard, Jr., assignor to The Champion Paper and Fibre Co. Filed July 25, 1950. 8 claims. (Cl. 260-124.) A lignin tanning agent to be used either alone or in combination with vegetable tanning agents is produced by the acidification of spent liquor to produce a precipitate. The precipitate is redispersed, then chlorinated until the product analyzes 15–30% combined chlorine.

June 2, 1953

2,640,305. Machine for gluing and sealing carton flaps. Frank C. Genco, Ernest R. Edmunds, and Nicholas Panzarella. (Edmunds and Panzarella's interests assigned to Genco.) Filed Aug. 1, 1949. 1 claim. (Cl. 53-145.) The bottom flaps of the carton are glued and sealed, the product (soap flakes, cereal, or the like) is placed in the carton, and the top flaps are glued and sealed.

2,640,401. Molded pulp carton press. Alfred E. Comstock, assignor to Shellmar Products Corp. Filed Sept. 9, 1950. 6 claims. (Cl. 92-68.) The press imparts a smooth ironed finish to the surface of molded pulp articles such as egg cartons.

2,640,402. Molded pulp carton press. Alfred E. Comstock, assignor to Shellmar Products Corp. Filed April 7, 1951. 6 claims. (Cl. 92-68.) This is similar to U. S. patent 2,640,401 (cf., preceding patent).

2,640,516. Bark-removing cutter reciprocable over step-by-step rotatable log. Price Wilson, assignor 50% to Linwood Manufacturing Co. Filed April 16, 1951. 10 claims (Cl. 144-208.)

2,640,539. Apparatus for cutting lengths from a web of paper, cardboard, or similar material. Ronald N. Piper, assignor to Powers-Samas Accounting Machines Ltd. Filed July 12, 1950. 5 claims. (Cl. 164-68.) Two rotatable knives are mounted in drum-shaped knife holders on either side of the web of paper, cardboard, or similar material.

2,640,540. Cutting shoe for bagmaking machines. Delmar Stange, assignor to Bemis Bro. Bag Co. Filed April 13, 1951. 5 claims. (Cl. 164-68.)

2,640,587. Disposable tissue dispenser and container. Mabel B. Smith. Filed Oct. 4, 1948. 2 claims. (Cl. 206-37.) A pocket package for about a dozen disposable tissues.

2,640,589. Drive-in theater service tray. Thomas W. Foster, Leonard E. Scheck, and Earl L. Bradley, assignors to Container Corp. of America. Filed March 5, 1952. 2 claims. (Cl. 206-72.) A compartmented tray of paperboard may be easily set up from the flat and locked into place; it holds beverage cups, ice cream cones, plates, and the like securely in the separate compartments.

2,640,642. Display carton. William P. Frankenstein. Filed Nov. 27, 1948. 7 claims. (Cl. 229-16.) This display carton from a single blank may be shipped in knocked-down form and set up by the user

2,640,643. Carton. William P. Frankenstein. Filed July 9, 1948. 11 claims. (Cl. 229-34.) Double walls in this carton hold small articles in place so that they can be viewed from several sides without removal.

2,640,644. Partition pad. Russell J. Hennessey and Morton B. Jameson, assignors to Waldorf Paper Products Co. Filed July 5, 1949. 6 claims. (Cl. 229-42.) A partition pad divides a rectangular container both horizontally and vertically.

2,640,660. Device for laterally adjusting webs. Richard Winkler and Max Dünnebier, assignors to Baltimore Paper Co. Filed June 2, 1951. 12 claims. (Cl. 242-76.) Feeler elements adjustable to the edge of the web actuate an electro-mechanical system for shifting one end of the roll shaft to compensate for a shift in web alignment.

2,640,758. Method of oxidizing sodium sulphide to sodium sulphite in successive stages. Robert S. Aries and Arthur Pollak. Filed Feb. 23, 1949. 6 claims. (Cl. 23-129.) Sodium sulphite is reclaimed from spent liquors of the sulphate and neutral sulphite processes by mixing the sulphide solution with sodium carbonate. Water must be added to continue the reaction until all of the sodium sulphide is oxidized to sulphite.

2,640,774. Production of cellulose pulp. James H. Ross, John S. Hart, Richard K. Strapp, and Otto Maass, assignors to Pulp and Paper Research Institute of Canada. Filed July 16, 1949. 8 claims. (Cl. 92-6.) Steam treatment of wood chips at pressures from 20 to 50 p.s.i. with subsequent rapid release to atmospheric pressure produces optimum "fiber saturation point" in the chips. This Va-Purge process may be repeated if desirable prior to the normal cooking cycle.

2,640,786. Coating composition and fire resistant building element coated therewith. Joseph R. Parsons, Morton C. Higgs, and Mary A. Loos, assignors to United States Gypsum Co. Filed July 8, 1948. 10 claims. (Cl. 106-282.) A fire-retardant coating for composition shingles is formed by the use of preformed mineral-wool pellets and asphalt.

2,640,790. Coated paper and process for making same. Edwin J. Barber, assignor to Hercules Powder Co. Filed Oct. 26, 1949. 3 claims. (Cl. 117-157.) A water-soluble metal salt of a cellulose ethyl ether β-sulphonic acid is employed as a binder for coating solids which may be clay, titanium dioxide, calcium carbonate, etc.

2,640,791. Coated paper. Edwin J. Barber, assignor to Hercules Powder Co. Filed Oct. 26, 1949. 4 claims. (Cl. 117-157.) This is similar to U. S. patent 2,640,790 (cf. preceding patent) except that a further treatment of the coating is claimed in which glyoxal, acetaldehyde, furfural, or formaldehyde are used to increase web-rub resistance.

2,640,799. Process of continuously uniting resin-impregnated cellulosic webs for decorative coverings. Donald H. Grangaard, assignor to Paper Patents Co. Filed May 19, 1948. 11 claims. (Cl. 154-138.) Contact pressure resins of the unsaturated polyester type are utilized in this laminating process.

2,640,814. Tall oil-polyamino-aldehyde reaction products. Alfred F. Schmutzler, assignor to American Cyanamid Co. Filed June 12, 1951. 19 claims. (Cl. 260-21.) Printing inks and architectural finishes are prepared from a product in which tall oil, dicyandiamide, and naphtha are reacted and then treated with an aqueous formaldehyde solution; the water is distilled off, leaving the resin.

2,640,822. Acylated complex oxygen-containing polyamines. Denham Harman and Harry J. Sommer, assignors to Shell Development Co. Filed Aug. 22, 1949. 8 claims. (Cl. 260-97.5.) These compounds are formed in a reaction involving anhydrous ammonia and acrolein in the presence of hydrogen under high pressure with a catalyst and methanol as a solvent.

2,640,823. Treatment of tall oil. Stewart W. Gloyer and Henry A. Vogel, assignors to Pittsburgh Plate Glass Co. Filed June 4, 1946. 17 claims. (Cl. 260-97.6.) A method for the purification of tall oil fractions is outlined with the objective of obtaining esters of tall oil and rosin acids substantially free of fatty acids.

June 9, 1953

2,641,028. Apparatus for fiber collection. Harmon Steele, assignor to Johns-Manville Corp. Filed July 6, 1948. 1 claim. (Cl. 19-156.) Fibers formed from molten glass, rock, slag, etc., are directed into a collection chamber by air streams, steam jet or other means; the bottom wall of the collection chamber is an endless belt upon which the felted layer is formed.

2,641,095. Machine for packaging stacked hollow ware such as nested paper cups or the like. Wendell T. Burbank, assignor to Sutherland Paper Co. Filed Jan. 13, 1949. 13 claims. (Cl. 53-88.) Machine completely wraps and seals nested paper cups or the like.

2,641,164. Method for processing fibrous pulp. Harold S. Hill and James T. Coghill. Filed July 8, 1946. 18 claims. (Cl. 92-20.) This process (i.e., Curlation) deinks, dewaters, fractionates, and removes soluble materials from pulp.

2,641,165. Apparatus for effecting disintegration of materials. Kurt Wandel. Filed Oct. 14, 1949. 4 claims. (Cl. 92-26.) Saucer-shaped rotors with an abrasive coating on the marginal area are mounted in the side walls of a vat. Wastepaper or other material is disintegrated by passing over the abrasive area.

2,641,167. Bag bottom forming device. Franco Gramegna, assignor to St. Regis Paper Co. Filed Oct. 9, 1950. 11 claims. (Cl. 93-22.) A device for forming bag bottoms for bags of either single or multiple-ply construction.

2,641,289. Bark-removing apparatus having log-rotating and log-advancing peeler heads. John B. Merrifield, assignor two thirds to James B. Fuller. Filed June 23, 1952. 14 claims. (Cl. 144-208.)

2,641,402. Cup-shaped foil capsule. Otto J. Bruun. Filed Jan. 14, 1948. 1 claim. (Cl. 229-4.5.) A cup-shaped container formed from a metal-foil blank with a pleated overlapping of the sides.

2,641,403. Handled cup. Kenneth T. Buttery and Louis W. Sutherland, Jr., assignors to Sutherland Paper Co. Filed April 16, 1947. 9 claims. (Cl. 229-52.) The handles of this paper cup are stamped as a part of the body blank.

2,641,469. Festoon drier. Alfred H. Pagell. Filed June 17, 1947. 15 claims. (Cl. 271-2.2.) The length of the festoon and the time of travel on the festoon chain are adjustable by simple means on this mechanism.

2,641,527. Recovery of sulphur from gases. Koerner E. Leutz, assignor to Sun Oil Co. Filed April 12, 1949. 6 claims. (Cl. 23-2.) An aqueous solution of an iron salt with a weakly acidic anion such as ferrous acetate, ferric formate, ferrous lactate, and ferrous tartrate may be used to remove hydrogen sulphide from a gaseous mixture.

2,641,528. Manufacture of chlorine dioxide of low chlorine content. Max L. Audoynaud, assignor to Mathieson Chemical Corp. Filed July 27, 1949. 3 claims. (Cl. 23-152.) The rate of reaction between a chlorate and a mineral acid is claimed to be controlled by the rate of air flow through the mixture. Very little chlorine is produced.

2,641,541. Production of fiber from flax straw. Sidney D. Wells, assignor to The Institute of Paper Chemistry. Filed Sept. 13, 1949. 4 claims. (Cl. 92-15.) Flax tow is soaked in dilute caustic soda for several days then given a second soak in dilute caustic soda for a day, beaten to separate the fibers, and washed to remove the caustic. Fibers so produced are not degraded.

2,641,557. Paper with improved printing characteristics. Barrett K. Green, assignor to The National Cash Register Co. Filed Nov. 18, 1948. 3 claims. (Cl. 117-152.) A clay material called Attapulgite or Attapulgus clay is composed of a majority of needle-shaped crystals. This clay when used as a paper filler or coating has the capacity to absorb fluids by means of the intercrystalline spaces resulting from the brush-pile structure. This prevents ink bleed on paper so treated.

2,641,558. Water repellence fixative treatment. Stephen F. Urban and Warren B. Blumenthal, assignors to National Lead Co. Filed Dec. 24, 1948. 7 claims. (Cl. 117-154.) Photographic papers are treated by fixation of water-repellent compounds by using basic zirconyl chloride, stannous chloride, or ferrous sulphate.

2,641,562. Decalcomania. Victor E. Chartrand and Paul E. James. Filed Nov. 2, 1950. 2 claims. (Cl. 154-46.8.) A paper-backed decalcomania embodies a permanently tacky water-insoluble coating on the face which is covered with a water-soluble coating. The water-scluble coating is a protection for the tacky coating and makes possible the piling of the decalcomanias.

2,641,584. Adhesive compositions, including an amylaceous material and a triazone. Thomas A. Martone, Jr., assignor to E. I. du Pont de Nemours and Co. Filed Oct. 26, 1951. 6 claims. (Cl. 260-17.3.) Water-resistant adhesive for corrugated board with a pot life of 24 hr. composed of diethylene triamine, urea, and formaldehyde is ready for use immediately after reaction.

June 16, 1953

2,641,781. Paper padding press. Herbert T. Haskell. Filed July 8, 1952. 2 claims. (Cl. 11-1.) Press for alignment and gluing of tablet pads.

2,641,803. Method and machine for removing fibers from plant stems. Karel Vonders, assignor 80% to Jacobus Nolten,

and 20% to Willem F. H. Zegers. Filed Feb. 16, 1948. 35 claims. (Cl. 19-13.) Bast fiber from the stems of flax, jute, ramie, etc., is separated from the nonfibrous material by breaking the stem between rollers, then placing the stem under tension and causing it to be vibrated rapidly. Root material is removed by pounding to crush the woody material.

2,641,827. Method of making fiber drums having metal closures. Herbert L. Carpenter, assignor to Carpenter Container Corp. Filed June 16, 1949. 2 claims. (Cl. 29-148.2.) Metal heads are attached to fiber drums by a device that forms a rolled bead with the metal and fiber.

2,641,850. Apparatus for continuously treating lengthy cellulose material. Julien Dungler. Filed Feb. 7, 1950. 1 claim. (Cl. 34-156.) A hot air or steam drier for paper and like material after dyeing or printing.

2,641,882. Bag packaging machine. Charles F. Richard, assignor to Niagara Packaging Machinery Corp. Filed Dec. 2, 1949. 15 claims. (Cl. 53-144.) Machine fills, folds over the end flap, and seals the bag by any of a number of means.

2,641,971. Paper stock pulper. Enright A. Ellis, assignor to Downingtown Manufacturing Co. Filed Feb. 7, 1949. 7 claims. (Cl. 92-23.) Pulper consists of a tank whose walls are concave lobes forming a clover-leaf shape in cross section; an impeller is mounted in the bottom and rotates in a horizontal plane.

2,641,972. Cylinder mold for papermaking machines. George A. Engert. Filed Nov. 21, 1949. 1 claim. (Cl. 92-43.) A cylinder mold for high-speed operation formed from a perforated cylindrical steel plate covered with wire mesh has no internal bracing spiders or bars, thereby reducing turbulence in the interior of the mold.

2,641,973. Machine for making paper boxes. Clayton Straw, assignor to Henry R. Davis, Jr. Filed Sept. 15, 1945. 27 claims. (Cl. 93-41.) Box blanks are set up and stayed with either heat-sealable material or glue coated strips. Rapidity of adjustment and handling very small boxes are features.

2,641,974. Apparatus for cutting and stacking sheet. Arthur F. Sperling and William E. Schroeder, assignors to Samuel M. Langston Co. Filed Aug. 5, 1949. 14 claims. (Cl. 93-93.) This machine cuts and stacks corrugated board then removes a predetermined number of boards from the bottom of the pile with a pusher device.

2,642,030. Roller coating machine for rigid sheet material. Edwin H. Brink, assignor to Masonite Corp. Filed July 28, 1949. 8 claims. (Cl. 118-114.) A coating device for coating materials such as hard board.

2,642,182. Greeting card and envelope assembly. William C. Baynes. Filed Oct. 23, 1947. 2 claims. (Cl. 206-63.) An adhesive coated tab to hold a greeting card and envelope together for display.

2,642,183. Carton. Louis F. Prossen, assignor to Celanese Corp. of America. Filed Jan. 25, 1950. 8 claims. (Cl. 206-65.) A carton for yarn spools or cones in which the core is engaged by U-shaped projections fitted into perforations in the separators.

2,642,187. Filter unit construction. Albert E. Bell, assignor to Purolator Products, Inc. Filed Jan. 11, 1950. 4 claims. (Cl. 210-169.) Sealing for the pleated filter element to the end disk with thermoplastic cement for filter cartridges.

2,642,188. Replaceable filter unit construction. Ralph R. Layte and Albert E. Bell, assignors to Purolator Products, Inc. Filed Nov. 16, 1951. 9 claims. (Cl. 210-169.) Method of cementing and sealing end disks to the pleated body material of a replaceable filter element made of resin impregnated filter paper.

2,642,196. Carton feeding machine. Raymond Vahle, assignor to Robert Gair Co., Inc. Filed Oct. 18, 1946. 9 claims. (Cl. 214-8.5.) Flat, folded carton blanks (such as for cellular egg cartons) are removed from a hopper, erected, and discharged into a magazine in internested relation.

2,642,218. Folding box locking structure. Samuel Platt. Filed Feb. 16, 1948. 3 claims. (Cl. 229-31.) Folding box for cakes, etc., in which the front wall may be locked in place independently of the cover.

2,642,279. Web interfolding apparatus and method. Oliver E. Teall, assignor one third to William Edds and one third to Douglas Crutchley. Filed Feb. 21, 1950. 18 claims. (Cl. 270-40.) A number of supply rolls are employed to form a continuous stack of interfolded tissue or toweling.

2,642,285. Blank magazine for folding box machines. Thomas R. Baker and Edward J. Pagendarm, assignors to Bemiss-Jason Machine Co. Filed Oct. 25, 1950. 4 claims. (Cl. 271-62.) Blank magazine for folding box machine.

2,642,349. Waterproof sandpaper and backing therefor. Carl W. Foss and Halsey W. Buell, assignors to The Carborundum Co. Filed Feb. 4, 1950. 16 claims. (Cl. 51-295.) Wet-strength paper is treated with a varnish made from maleic anhydride, castor oil, and glycerine to produce a flexible backing paper.

2,642,359. Process of making fiberboard from groundwood. Wylmer L. Scott, assignor to Armstrong Cork Co. Filed Aug. 18, 1947. 7 claims. (Cl. 92-1.) A method of grinding is described whereby the long axis of the wood bole is transverse to the axis of rotation of the grinding stone.

2,642,360. Manufacture of wet-strength paper. Herbert W. Mackinney and Sidney J. Schultz, assignors to Union Carbide & Carbon Corp. Filed Dec. 27, 1946. 5 claims. (Cl. 92-21.) A urea-formaldehyde resin which is soluble in an alkaline aqueous medium is produced by treating the resin with resorcinol dissolved in ethyl alcohol and heating, then adjusting the pH to 8 with triethanolamine.

2,642,366. Method of coating sheet material with wax. George G. Rumberger, assignor to Marathon Corp. Filed March 23, 1951. 17 claims. (Cl. 117-103.) Adjustment of surface tension in the quenching bath to approximately that of the coating prevents the formation of flow lines on waxed board.

2,642,372. Flexible corrugated sheet material and method of fabricating same. Charles Y. Chittick. Filed Feb. 2, 1950. 11 claims. (Cl. 154-55.) Flexibility is achieved in single-face corrugated board by cutting across the flutes at controlled intervals.

2,642,399. Process for dissolving ash containing sodium sulphide and sodium carbonate. Robert S. Aries and Arthur Pollak. Filed Feb. 23, 1949. 3 claims. (Cl. 252-183.) Molten ash from the recovery furnace is dissolved in a concentrated solution of sodium sulphide which is constantly circulating and to which water is added as the ash is dissolved. Sulphate and carbonate present in the ash have only a limited solubility in the concentrated sulphide solution.

2,642,405. Fire-retarding coating composition composed of nitrogen-phosphorus compound with an aldehyde resin. Morris L. Nielsen, assignor to Monsanto Chemical Co. Filed Dec. 30, 1948. 5 claims. (Cl. 260-29.4.) A water-insoluble polyphosphorylamide compound formed by the reaction of phosphoryl chloride with anhydrous ammonia in a hydrocarbon solvent is included in paint to form a self-extinguishing composition for application to fiberboard, paper, and the like.

June 23, 1953

R23,669. Container flap folding apparatus. Samuel H. Berch, assignor to Arden Farms Co. Filed Jan. 19, 1953. 3 claims. (Cl. 53-96.) Reissue of U. S. patent 2,500,922 (March 21, 1950). This machine forms the carton from a precut blank, fills it with ice cream, and closes the top of the carton after filling.

R23,670. Integral carton for protection of fragile articles. John F. Currivan. Filed March 30, 1953. 9 claims. (Cl. 229-38.) Reissue of U. S. patent 2,611,529 (Sept. 23, 1952).

2,642,707. Package wrapping machine. Oscar Sandberg, assignor to Lynch Corp. Filed Jan. 29, 1949. 22 claims. (Cl. 53-42.) Machine for wrapping cookies or crackers in units of four or five per package.

2,642,781. Paper machinery. William D. Croake and Billie D. Ellis, assignors to The Black-Clawson Co. Filed June 12, 1951. 8 claims. (Cl. 92-27.) A control device for jordans, attrition mills, and the like.

2,642,782. Fiberboard forming press with loader and unloader. Ralph Chapman, assignor to Chapman Forest Utilization, Inc. Filed April 10, 1948. 2 claims. (Cl. 92-61.) Endless screens are employed to carry wet mats into the press and the finished board out of the press. The screens operate about heated platens and are opposed by smooth platens which form a smooth face on the board.

2,642,783. Beading roller for cartons. Theodore W. Goodrich. Filed Dec. 6, 1951. 2 claims. (Cl. 93-36.5.) Folded flaps on cartons do not tend to spring back to the original position.

2,642,784. Machine for making paper containers. Bruno A. Wittkuhns, H. George D. Nutting, and Gilbert F. Hill, assignors to National Paper Bottle Co., Inc. Filed April 6, 1949. 33 claims. (Cl. 93-39.3.) Machine for forming cylindrical paper milk cartons.

2,642,785. Machine for making paper containers. Bruno A. Wittkuhns, H. George D. Nutting, and Gilbert F. Hill, assignors to National Paper Bottle Co., Inc. Filed April 6, 1949. 32 claims. (Cl. 93-36.5.) Similar to U. S. patent 2,642,784 (cf. preceding patent).

2,642,786. Apparatus for forming and assembling egg cartons. John Gilchrist, assignor to Robert Gair Co., Inc. Filed Nov. 26, 1949. 24 claims. (Cl. 93-37.) Apparatus for forming and assembling egg cartons.

2,642,904. Log debarker and chipper. John H. Pearce. Filed Feb. 6, 1951. 6 claims. (Cl. 144-208.) Cutters are mounted on a chain which is brought into contact with the log.

2,642,950. Deaerating a suspension of cellulosic fibers. Carleton L. Clark, Carlo Vicario, Cornelius J. Lyons, James A. Smith, and William W. Hickey, assignors to The Rotareaed Corp. Filed Nov. 30, 1951. 12 claims. (Cl. 183-2.5.) Special nozzles and a tank maintained at subatmospheric pressure are employed to deaerate papermaking stock.

2,642,988. Carton for commodities and premium display. Claude C. Freeman, assignor to Container Corp. of America. Filed Aug. 31, 1950. 1 claim. (Cl. 206-45.14.) Carton for commodities and premium display.

2,642,989. Shipping device. George W. Keiser, Jr., Herbert D. Muise, and William A. Miller, assignors to Robert Gair Co., Inc. Filed Oct. 17, 1950. 11 claims. (Cl. 206-52.) A paperboard or corrugated board reel for shipment of heavy articles such as link chain.

2,643,012. Apparatus for the transportation of pulpwood and the like. Harold F. Wahl, assignor to Hyster Co. Filed May 23, 1950. 4 claims. (Cl. 214-85.1.) A logging arch modified by the addition of an apron for support of sling loads of pulpwood.

2,643,016. Carton taping apparatus and method. Charles W. Steckling, assignor to Jos. Schlitz Brewing Co. Filed Nov. 18, 1949. 14 claims. (Cl. 216-22.) Carton taping apparatus and method.

2,643,046. Multiple utility clamp and bracket. Joseph A. Humphreys. Filed Jan. 13, 1949. 2 claims. (Cl. 229-6.)

2,643,047. Interlocked hinged closure. Joseph A. O'Reilly, assignor 50% to William P. Hooker. Filed May 1, 1948. 1 claim. (Cl. 229-44.) Tongue members formed by arcuate-shaped slits lock into slits formed in the opposite member.

2,643,048. Paper container with slip resistant coating. Ivan V. Wilson, assignor to Monsanto Chemical Co. Filed Sept. 20, 1947. 7 claims. (Cl. 229-53.) Colloidal silica is applied to container surfaces to provide slip resistant coating.

2,643,049. Quick opening bag. Harold L. Bartelt. Filed Sept. 11, 1951. 7 claims. (Cl. 229-62.) A seal strip coated with microcrystalline wax or the like is heat sealed across the top of the bag.

2,643,050. Protective wrapper for automobile doors. Michael P. Williams, assignor to Cadillac Products, Inc. Filed March 20, 1951. 8 claims. (Cl. 229-87.)

2,643,080. Disposable pallet. Lawrence E. Vogel, assignor to Arkrell and Smiths. Filed April 19, 1949. 3 claims. (Cl. 248-120.)

2,643,117. Automatic control system. Stewart E. Frisbie, William O. Smiley, and Joseph C. Frommer, assignor to Electric Eye Equipment Co. Filed Aug. 29, 1949. 3 claims. (Cl. 271-2.6.) A pair of photocell detecting devices are coupled through an evaluator to correct misalignment of a paper web entering a press, etc.

2,643,120. Suction blank feed for printing, wrapping, and other machines. Donald R. P. Jackson, assignor to Molins Machine Co. Ltd. Filed Nov. 8, 1949. 2 claims. (Cl. 271-32.) The suction cup is positioned so that a part of the aperture extends past the edge of the blanks.

2,643,121. Sheet feeding apparatus. Headley T. Backhouse. Filed Nov. 9, 1949. 4 claims. (Cl. 271-50.) A suction roller imparts final movement of the sheet to bring it against the stops in the layboy.

2,643,176. Compositions for protection of metals against corrosion. Aaron Wachter and Nathan Stillman, assignors to Shell Development Co. Filed Oct. 28, 1946. 10 claims. (Cl. 21-2.5.) Kraft paper, waxed paper, and paper laminates have, among other materials, been found to be effective carriers for vapor phase inhibitors used in the packaging of metals to prevent corrosion.

2,643,177. Vapor phase corrosion inhibition of metals. Aaron Wachter and Nathan Stillman, assignors to Shell Development Co. Filed May 7, 1946. 12 claims. (Cl. 21-2.5.) This is similar to U. S. patent 2,643,176 (cf. preceding patent).

2,643,178. Corrosion inhibition. Aaron Wachter and Nathan Stillman, assignors to Shell Development Co. Filed April 19, 1946. 15 claims. (Cl. 21-2.5.) This is similar to U. S. patent 2,643,177.

2,643,186. Process of forming artificial board. Gordon E. Tower, assignor to Chapman Forest Utilization, Inc. Filed April 10, 1948. 2 claims. (Cl. 92-21.) 3.5% resin on the fiber basis is added as alkaline phenol-formaldehyde to produce a strong, rot-resistant hardboard.

2,643,194. Liquid glue. Louise K. Fencil, assignor to Armour and Co. Filed Nov. 18, 1946. 5 claims. (Cl. 106-135.) A halogenated alcohol such as ethylene chlorohydrin reduces the gelling tendency of animal glue and increase the working life of the glue.

2,643,200. Polymer treatment for fiberboards. Mack C. Fuqua. Filed Aug. 16, 1950. 4 claims. (Cl. 117-59.) A hydrocarbon fraction cracked under specified conditions produces a polymer useful as a drying oil type material which may have sulphur added to make it more valuable as a board treating agent.

June 30, 1953

2,643,378. Box assembling machine. Oscar H. Williamson, assignor to International Paper Co. Filed May 11, 1951. 2 claims. (Cl. 1-11.) Stitching machine for the assembly of single units.

2,643,475. Machine for applying decal films to base sheets. Jess D. Klopfenstein, assignor to The Meyercord Co. Filed April 22, 1950. 7 claims. (Cl. 41-1.) Machine adapted for application of decalcomania transfers by heat and pressure to base sheets of wood, fibrous materials, etc.

2,643,487. Method of producing batts of silica fibers. Leon Parker, assignor to The H. I. Thompson Co. Filed March 23, 1951. 5 claims. (Cl. 49-77.) Kraft paper is employed to form the batts preparatory to firing.

2,643,496. Enclosing articles in tubular wrappers. William S. Cloud. Filed March 15, 1947. 5 claims. (Cl. 53-89.) Machine for sealing tubular wrappers on candy bars.

2,643,497. Carton opening, filling, and closing mechanism. Robert O. Woelfer. Filed Oct. 8, 1949. 19 claims. (Cl. 53-91.)

2,643,499. Wrapping machine. Carl A. Gerlach. Filed Aug. 11, 1949. 5 claims. (Cl. 53-102.) Machine for wrapping large cylindrical objects such as rolls of paper.

2,643,500. Wrapping machine. Leonard Brook, assignor to The Forgrove Machinery Co. Ltd. Filed April 21, 1952. 5 claims. (Cl. 53-126.) Machine for twist or bunch wrapping of such articles as confectionery.

2,643,586. Screen apparatus. Julius J. Colvin. Filed May 16, 1951. 4 claims. (Cl. 92-31.) Method of clamping screen plates.

2,643,587. Lump breaker construction. Paul A. Fasoli, assignor to The Sandy Hill Iron & Brass Works. Filed July 1, 1950. 1 claim. (Cl. 92-47.) An idler roll suitably mounted with tension adjusting means for breaking lumps in a paper web.

2,643,588. Mechanism and method for forming sleeved valve bags. Edwin E. Burroughs, assignor to St. Regis Paper Co. Filed Sept. 29, 1949. 27 claims. (Cl. 93-8.)

2,643,589. Method of making cartons and carton blanks. Arthur J. Weiss, assignor to Robert Gair Co., Inc. Filed Sept. 19, 1950. 5 claims. (Cl. 93-36.) Duplex end flaps are formed by folding flaps of the carton blank back and attaching the edge, then severing the paperboard at the crease.

2,643,590. Machine for assembling paperboard partitions. Heinz Ahlmeyer and Whitney D. Sherman, assignors to Robert Gair Co., Inc. Filed June 21, 1948. 4 claims. (Cl. 93-37.)

2,643,591. Automatic means for making special cardboard containers. Leo D. Overland and Jack W. Levine. Filed Feb. 15, 1950. 1 claim. (Cl. 93-49.) Heated press rolls are employed for forming a special channel in a paperboard container.

2,643,592. Carton forming machine. Georges Geffroy, assignor to La Cellophane. Filed May 6, 1950. 1 claim. (Cl. 93-51.) A heat-sealable material such as cellophane is formed into a rectangular, open-topped box to act as a liner for food products and the like.

2,643,593. Method of producing multi-ply metal-foil-cardboard material and of producing articles formed of such material. Frederick P. Lenard and Geoffrey W. Methven, assignors to The New Merton Board Mills Ltd. Filed Oct. 30, 1948. 8 claims. (Cl. 93-55.1.)

2,643,594. Envelope machine. Ernst C. Sauerman. Filed Oct. 28, 1950. 6 claims. (Cl. 93-62.) Blanks for end-opening envelopes are scored and folded, adhesive applied, then the flaps folded to form the complete envelope.

2,643,656. Sanitary napkin. Ralph L. Atkinson, assignor to Personal Products Corp. Filed Oct. 31, 1950. 9 claims. (Cl. 128-290.) A fluff pad individually wrapped is superposed on each side of a central pad of absorbent tissue wadding.

2,643,691. Hydraulic log debarker. Arthur Rockwood, assignor to Worthington Corp. Filed April 9, 1952. 7 claims. (Cl. 144-208.) Nozzles are controllable so that the streams directed at the log are governed by log diameter.

2,643,716. Means for cutting the wrapper from rolls of newsprint and the like. Willard L. Oelkrue. Filed Dec. 4, 1950. 4 claims. (Cl. 164-39.) Circular headers are cut from the roll, then the cylindrical part of the wrapper is severed by a saw which is accurately positioned for depth of cut. Damage to the roll is eliminated.

2,643,719. Web-slitting machine with minutely variable cutting-roll equipment. Max Schneider. Filed April 20, 1950. 12 claims. (Cl. 164-70.) Unequally spaced cutting grooves in the cutting sleeve allow a more closely graduated combination of cutting widths.

2,643,720. Apparatus for cutting sheet material. William S. Miles, assignor to Johns-Manville Corp. Filed May 27, 1948. 4 claims. (Cl. 164-73.) An arcuate-shaped knife mounted on a channel frame for cutting asbestos cement board and the like.

2,643,810. Chick box. Hugh P. Fleming, assignor to Fleming Specialty Co. Filed Sept. 13, 1949. 1 claim. (Cl. 229-15.) End portions of the partitions extend above the perforated lid to ensure ventilation in stacked boxes.

2,643,811. Display carton. Hubert V. Bolding, assignor to The Bradley & Gilbert Co. Filed April 14, 1949. 3 claims. (Cl. 229-27.) Container for bottles and like products.

2,643,812. Box construction. Ferdinand Lange, assignor to Werner Bahlsen. Filed July 24, 1950. 4 claims. (Cl. 229-31.) A number of pleats are folded to form the corner resulting in a reinforced corner construction.

2,643,813. Carton. Oscar L. Vines, assignor to Alford Cartons. Filed Aug. 24, 1951. 5 claims. (Cl. 229–31.) Paperboard tomato tray.

2,643,814. Carton for round-ended articles. Harry Bradley, assignor to John Waddington Ltd. Filed Oct. 17, 1949. 1 claim. (Cl. 229-37.) Carton for electric light bulbs.

2,643,815. Sanitary milk carton. Oscar Komeo. Filed Jan. 26, 1951. 2 claims. (Cl. 229-44.)

2,643,878. Folding machine for continuous strips of stationery. John Lach, assignor to Uarco, Inc. Filed Aug. 14, 1950. 6 claims. (Cl. 270-39.) Strip forms are interleaved with carbon paper and folded into a zig-zag stack.

2,643,880. Sheet transfer means. Frank S. Elsaesser. Filed Nov. 14, 1947. 8 claims. (Cl. 271–42.) A patty of ground meat is formed between folds of a suitable paper which acts as a wrapper for the meat.

2,643,953. Process of making adhesive from lignocellulose. William Schoen, assignor to Masonite Corp. Filed July 1, 1949. 8 claims. (Cl. 106-163.) Dried, water-soluble lignocellulosic material is washed with methanol, then the methanol removed with an anhydrous aliphatic solvent and the product dried.

LETTERS TO THE EDITOR

Temperature in Corrugated Board Manufacture

To the Editor, *Tappi:*

While it is realized that corrugators in the United States operate at far greater speeds than in this country, we are hopeful that one or other of your members may be able to give us a reply to the problem we set out below:

What is the minimum temperature required to make good board with optimum flat-crush values, under the following conditions:

(a) Speed, 60 and 80 f.p.m.
(b) Length of hot plate section on single facer, 12 ft., 1 in.
(c) Length of hot plate section on double backer, 19 ft., 7 in.
(d) One $10^1/_2$-in. diameter stationary preheater with 120° arc of contact for liner on single facer.
(e) One $10^1/_2$-in. diameter stationary preheater with 160° arc of contact for liner on double backer.
(f) No preheater on fluting medium.
(g) Steam shower on one side of fluting medium.

Material: Corrugating medium 0.009 in., 26 lb. per 1000 sq. ft. Liners both 0.020, 64 lb. per 1000 sq. ft.

B. Gershill, *Manager*
Standard Canners & Packers, Ltd.
Port Elizabeth, South Africa

To the Editor, *Tappi:*

The problem posed by the letter from Standard Canners & Packers Ltd., which you submitted with your letter of Sept. 2, 1953, is indeed one of interest. In reading the conditions which have been described, it is obvious that this is a nonpressure-type corrugator which bears very little relation to the pressure type in common usage in this country. Although our company has a machine of similar nature in operation at the present time, our operating speeds exceed those given in the subject case three to fourfold and it is almost impossible for me to translate from one set of conditions to another.

I can give you only a general answer to Mr. Gershill's problem and this must be considered carefully depending on whether starch or silicate type adhesives are being used.

First, high temperatures at the corrugating rolls will be required in order to develop the maximum potential inherent to any particular corrugating medium. Normally, we think of 175-lb. steam pressure at the single facer to be a requirement for high-speed operation in the range of 400 to 500 f.p.m. on a pressure-type machine. Lower speeds on any type machine will require a somewhat lower temperature. The exact range is only a guess, but it would be my estimate that 125 p.s.i. is a reasonable level. Temperature conditions in the hot plate sections and the preheating rolls need not be this high and only a careful study of the speed, the retention time, the gel point in the case of starch, and the set time in the case of silicate can determine the proper level for operation on an open machine at speeds from 60 to 80 f.p.m.

I am sorry that I cannot be of more specific assistance to Mr. Gershill, but the conditions of operation of his machine are so different from any in my past experience that only a guess would be the result of any attempted calculation. You might contact some of the other members of the industry for their reaction to this problem. Perhaps some further information could be derived by this method.

Keith W. Max, *Assistant to Vice-President*
Folding Carton Div., Robert Gair Co., Inc.
New York, N. Y.

To the Editor, *Tappi:*

Regarding the letter from Mr. Gershill of Standard Canners & Packers Ltd., in Port Elizabeth, S. A., I am in doubt as to what he means by hot plate section on a single facer, and have had no experience with corrugating machines running as slowly as the one he describes. However, by using our experience and some engineering principles, I will attempt to answer his question:

I believe that the formation of the corrugating medium in the nip of the corrugator rolls is very definitely a function of the temperature of the paper in that nip. The temperature of the paper is a function of the heat transfer from the rolls to the paper and the time of contact. Since the specific heat of paper is not a function of temperature, operating at the speed cited in the letter, the corrugating medium would tend to heat to four times the temperature of our machines based on time alone. Since the heat transfer is a function of temperature difference between the rolls and the paper, the driving force for heat transfer must be sufficient to supply one-quarter of the heat supplied to our corrugating medium. A logarithmic mean temperature driving force would indicate that a steam pressure as low as 68 lb. p.s.i. would give satisfactory performance supplying about one half of the heat transfer per unit time as occurs on our machines, providing there is proper drainage of condensate from the corrugating rolls, and no unusual film formations on the inside of the rolls. The saturation temperature of steam at this pressure is about 300°F.

The rule of thumb for heat loss to the surface of a corrugator roll is about 10% of the saturated steam temperature. Therefore, the corrugator roll surface temperature should be about 270° to form good flutes at speeds of 60 to 80 f.p.m.

Steam pressure in the neighborhood of 150 p.s.i. I believe that would be too much heat for board traveling at this slow speed, and would promote crystallization of the single facer and double backer adhesives.

I hope that this analysis of the question may be of some help to Mr. Gershill.

Burt Mendlin, *Chairman*
TAPPI Corrugated Containers Committee

Germanium Dioxide in Trees

To the Editor, *Tappi:*

The Industrial Division of the Signal Corps Supply Agency has been conducting a survey to determine all present and potential sources for germanium dioxide. This material is required for use in the manufacture of diodes, triodes, and power rectifiers. The development of mass production techniques is expected to create an increased demand for this material.

According to Hans Brauchli, who is associated with Johns Hopkins University, Baltimore, Md., germanium dioxide is present in trees. The compound is reported to be found not only in the wood itself but also in the leaves and bark of trees. The amount of germanium dioxide found in this forest product is said to be of commercial significance. It has also been suggested that during the manufacture of paper pulp, germanium dioxide may be leached out and possibly could be recovered from the solution.

This agency is interested in exploring this approach and would like to have your opinion as to its potential value. If you would supply this agency with a listing of the leading pulp and timber companies so that we can determine if any work has already been done in this field, that would be helpful.

Your cooperation in this matter is appreciated and will be an aid in our materials planning program for national defense.

WALTER G. SHAFFER, *Major, Signal Corps*
Chief, Production Development Branch
Industrial Div., Philadelphia, Pa.

To the Editor, *Tappi:*

An examination of the literature has brought to light but little information about the occurrence of germanium in wood. Some study has been made of other plants, and particularly of fossil remains such as coal. It seems safe to say that information of the type that you desire is not available. Institutionally, we have no information regarding the presence of germanium in either wood or processing materials. A complete answer to the question would include the germanium content of various species of woods, of barks, the effect of growth conditions, and the carry-over of the germanium originally present to processing and waste liquors, gases, etc.

A survey of wood, etc., as a source of germanium would require separate analyses of wood and bark, and possibly of other parts of the tree. Enough species should be examined to establish the effect of this factor, and geographical location and effect of soil composition would require study. Work of this kind would establish the potential germanium content of forest products. The tropical woods might be examined also. Some of these have relatively high silica contents, and examination for germanium might be justified.

If forest products were to serve as a practical source of germanium, it would be necessary to locate germanium-rich concentrates in sufficient quantity to merit consideration. Two kinds of concentrates might be found in (1) ash from wood products or (2) processing liquors or gases.

The ash from wood burning would represent collection problems except where wood is burnt in considerable quantity. One of the richest sources of wood ashes might be the sawdust burners which are located in the proximity of sawmills in several sections of the country, and those power plants burning mixed or hogged wood waste. Analysis of the products of such burners would establish the potential yield of germanium.

Wood bark is burned in considerable quantity by a number of mills, primarily as a method of disposal, although the heat value of the fuel is recovered. Analyses of the ash from this operation (including ash collection equipment) would establish whether any unusual amount of germanium occurs in bark and whether that present would be recoverable. Incidentally, at least one pulp and paper mill is burning peat in large tonnages.

The practicable recovery of germanium from wood or bark ash would require consideration of available raw materials and the difficulty of recovery. On the latter point we have no information at all; that is, we do not know what the level of germanium content must be in a raw material to make recovery commercially feasible. The total amount of raw material available from ashes is difficult to establish without a detailed survey. However, an idea of order of magnitude may be obtained from the fact that one mill alone burns approximately 100 tons of dry bark and wood refuse daily. One such mill could therefore produce about 1 ton of ash per day, if an ash content of one per cent is assumed and no fly ash were lost. It must be understood that such availability figures would be extremely tentative.

The possible recovery of germanium from processing and waste liquors appears to be a less feasible source. Even if the major portion of the germanium present were extracted in the pulping liquor, the addition of the inorganic substances in the pulping chemicals would represent an undesirable dilution in that it would result in a decrease of the germanium content (based on total inorganic materials) to a small fraction of that in the ash. Thus, the problem of recovery would be an acute one at best, although recycling of cooking chemicals would probably result in some enrichment.

Altogether, the utilization of processing liquors does not appear bright. However, for a complete survey it might prove worth while to examine typical materials of the following types:

1. Kraft smelt from mills located in various sections of the country, e.g., west coast, southern, northern, etc.
2. Recovered salt cake from kraft mill flue gases. A concentration of germanium might be found.
3. Magnesia from sulphite liquors as recovered in west coast mills.

Other possible locations of concentrates might be found on a smaller scale. For example, prehydrolysis liquors might be examined. However, the above should set the pattern of study.

A general survey covering the areas discussed above presumably could be pursued in a relatively straightforward manner. No detailed study of methods of analysis has been carried out, but a considerable number of qualitative and quantitative methods have been described in the literature.

C. B. SITTERSON, JR., *Secretary*
Institute of Paper Chemistry
Appleton, Wis.

Specifications for Corrugating Paper

To the Editor, *Tappi:*

We have for a considerable period been experimenting with the furnish used for fluting papers in order to manufacture fluting papers of sufficient rigidity and stiffness to satisfy the local corrugated container market.

Our experiments have been unsuccessful up to the present time and the Union Corrugated Container Association has suggested that we write to you for details of the specification for fluting papers used in the United States of America, and for any other information you may be able to supply to us on the process of obtaining rigidity in fluting papers.

It would be of considerable assistance to us to obtain this information and we look forward to receiving your cooperation and help in this matter.

H. EASTGATE
Premier Paper Mills, Ltd.
Johannesburg, South Africa

To the Editor, *Tappi:*

In regard to the request from Mr. Eastgate of the Premier Paper Mills Ltd., Johannesburg, S. A., for specifications on fluting paper, which I interpret to be corrugating medium in our country, I must admit there are no specifications as to rigidity. Corrugating medium is manufactured in accordance with the requirements of Rule 41 (Association of American Railways) which specifies that the medium shall be in excess of 26 lb. per 1000 sq. ft., and that the caliper shall be in excess of 0.009 in.

The Container Laboratories, Inc. do considerable consulting work for the corrugating containers industry and have set

up certain specifications as to ring stiffness of all components of containers.

Various mills are using The Institute of Paper Chemistry single flute tester, others are using a Concora crush tester. At least several of the mills have adopted a value of 42 lb. per sq. in. on The Institute of Paper Chemistry single flute tester as being a desirable value. Practically all the box plants evaluate the corrugating medium on the flat crush of the combined board. Generally speaking, a value of flat crush on the combined board in excess of 45 p.s.i. for B-flute is considered acceptable; and anything in excess of 40 p.s.i. for C-flute as being acceptable.

W. W. MARTENY, *Secretary*
TAPPI Corrugated Containers Committee

To the Editor, *Tappi:*

I can give you only a general answer on the procedures for increasing the rigidity of corrugating medium. There has been a large amount of work done on this subject and significant progress has been made by a number of companies by methods which are, in general, not closely related. The following may be of some assistance to Mr. Eastgate and I have no objection to your passing them along to him for what they are worth:

1. Some of the most significant gains in the industry producing corrugating medium in the United States have been the result of improved pulping methods which permit the retention of large amounts of hemicellulosic components in the finished pulps, as an example, various neutral sulphite semichemical pulps which are being produced have shown improved rigidity over those pulps which are produced by full chemical treatment. Normally, species of hardwood pulpwood are used in this process. The value, of course, stems from the abundance of hardwoods available, as well as their high pentosan and hemicellulosic content.

2. The use of beater and surface additives in the production of corrugating medium has proved successful on some types of wastepaper and virgin pulp sheets. Various starches, gums, and synthetic resins have been used for this purpose. The large amounts usually necessary to accomplish significant gains sometimes are too costly to be practical. However, some practical increases in rigidity have been derived by treatments with starch and mannogalactan gums in a cost range of $5.00 per ton.

3. The increased application of refining power to produce lower freenesses to the paper machine will produce increased rigidity provided the mechanical means are available for handling this furnish. Furthermore, higher headbox consistencies, although they produce poorer formation, sometimes aid in retaining fines and additives to the extent that improved rigidity results.

There have been a number of other approaches aimed at increasing the rigidity of corrugating medium, but in general no significant improvement has resulted which will justify the cost incurred. I should like to point out at this time that there is a significant difference between the rigidity of the flat sheet as measured by conventional methods and the rigidity which is potential to the sheet after corrugation. It is sometimes the case that sheets exhibiting a softness and limpness will develop into a very rigid fluted board. In every instance it will be necessary to evaluate the results from changed procedures by corrugating the material and evaluating the fabricated board.

KEITH W. MAX, *Assistant to Vice-President*
Folding Carton Div., Robert Gair Co., Inc.
New York, N. Y.

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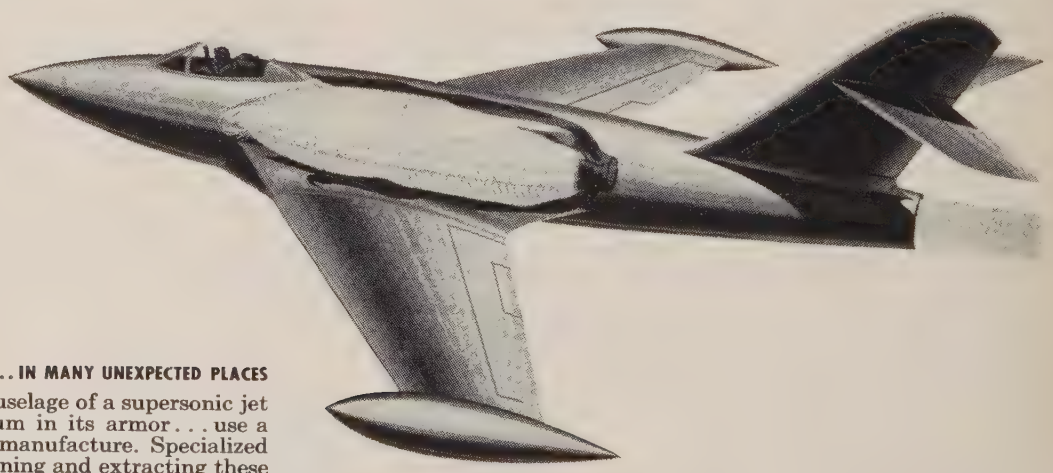

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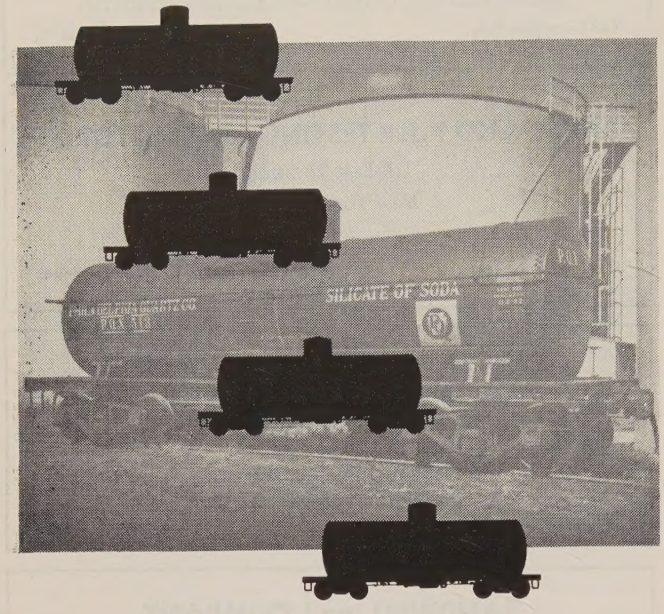

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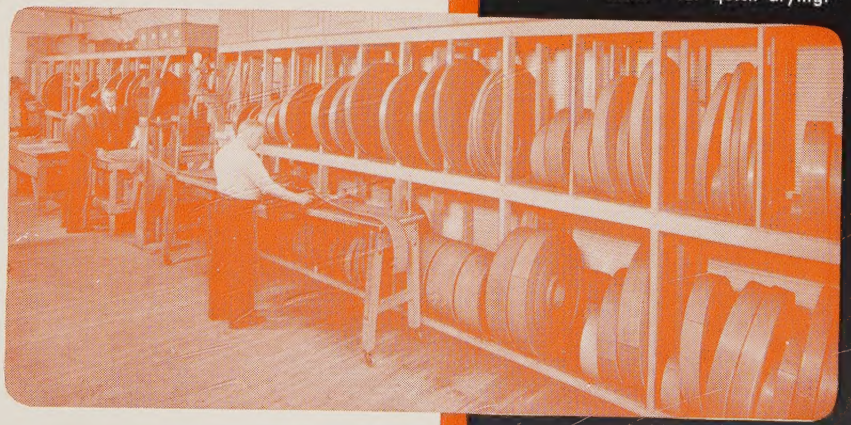

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